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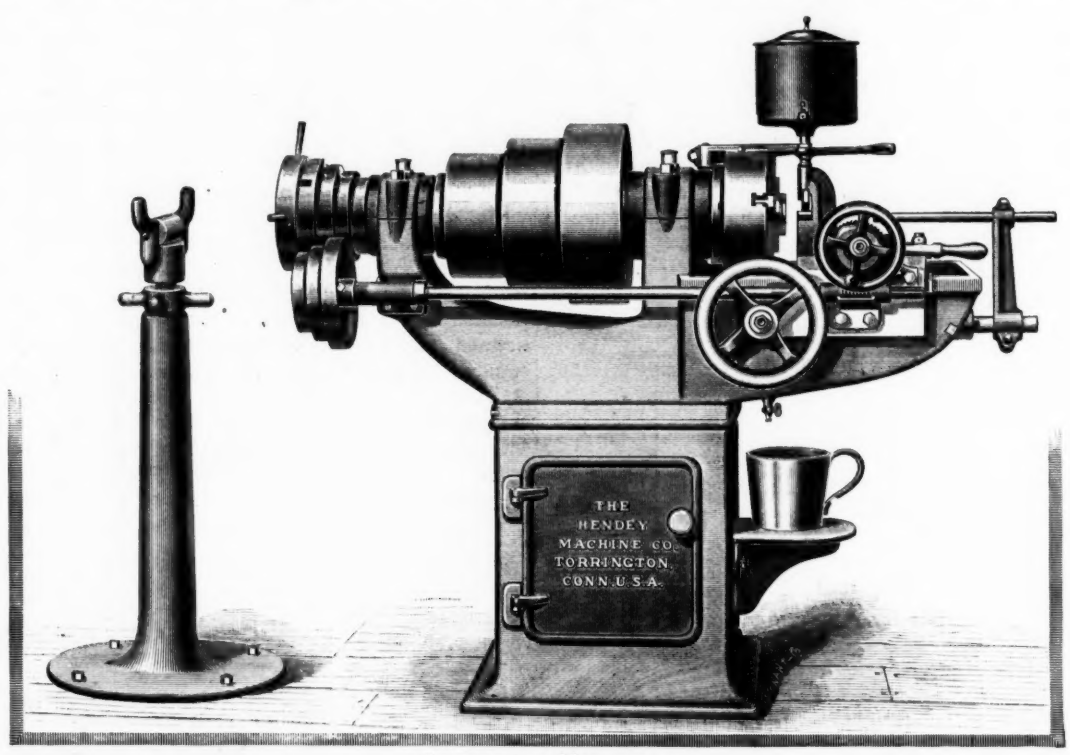
## Twenty-one Inch Lathe—Cutting-off Machine.

On this page we present illustrations of two machines which have recently been added to the list of tools built by the Hendey Machine Co., Torrington, Conn.

The first of these is a cutting-off machine for cutting stock up to 2½″ diameter, which, besides all the usual features found in such machines, has a tool-post, which is arranged to raise and lower the tool, and a carriage, which can be moved along the bed the same as a regular lathe carriage, so that a number of short pieces can be cut off a bar in succession, without the necessity for moving and resetting it in the chuck. The outer support for the bar is adjustable vertically to suit stock of varying diameters, and also is provided with a roller on which the bar rests, and is thus easily moved along and adjusted. The usual gauges and conveniences for handling oil and chips are provided, as shown in the engraving.




CUTTING-OFF MACHINE.

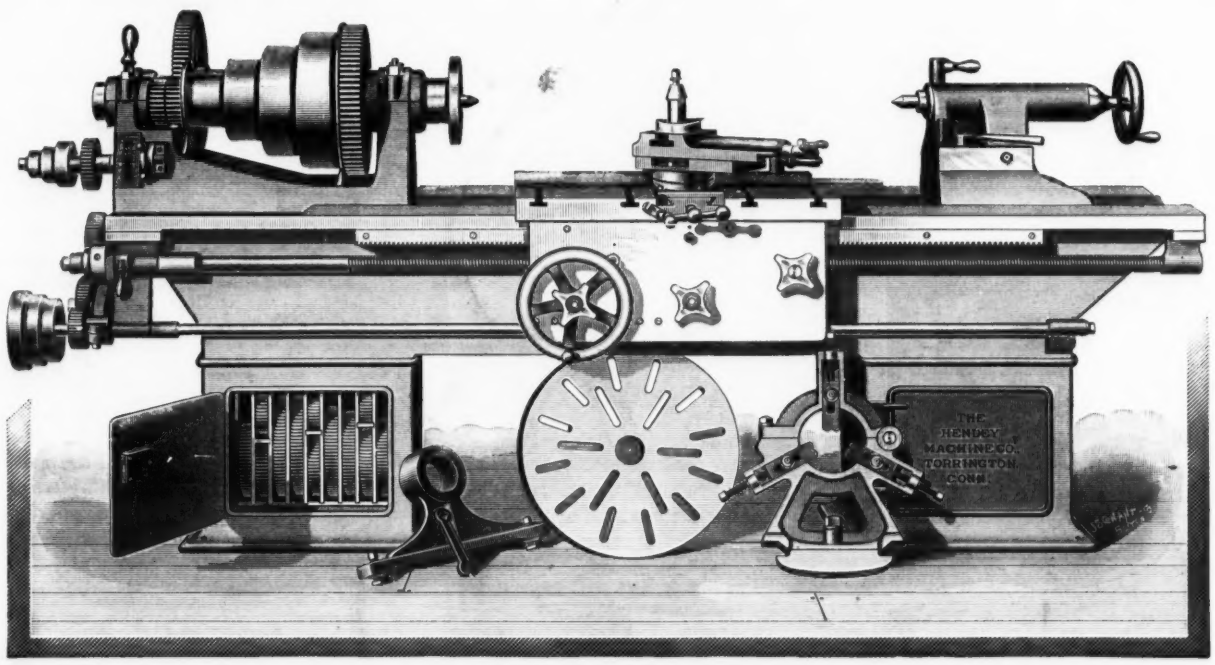
The front bearing is 4⅜″x6″. The cone pulley is for a 4″ belt, and its largest diameter is 13″. Weight of machine, 1,400 pounds.

The lathe shown is of 21″ swing, and, in some of its features, differs from the smaller ones of the same general style which we have illustrated heretofore. The pillars upon which it stands are made to serve the purpose of cupboards, one of them being specially prepared for keeping the change gears in it, and both having locks on the doors. The pillars, as will be noticed, are not at the extreme ends of the bed, but are carried in for the purpose of reducing the tendency to flexure as much as possible, and the superfluous metal then removed from the ends, giving, as will be seen, a design of pleasing appearance, while at the same time placing the metal in a position more in accordance with that indicated by the strains the tool is subject to, than is the case with the common practice.

The feed rod may be driven either by belt or gears, as may be desired, and there is an automatic cross-feed and compound rest.

The hole through the spindle is 1¾″ diameter; lathe swings over bed, 21½″; over carriage, 14⅝″. Cone pulley is for a 3½″ belt, and its largest step 13″ diameter, with back gear in the ratio of 13 to 1. Spindle bearings are of hard bronze, so made as to be easily renewed, and the front bearing is 3⅝″x5¼″.

Foot-stock is 14″ long, and its spindle 2½″ diameter. Bed is 19½″ wide, 14½″ deep, with cross-webs inside 27″ apart and 4″ wide. Screw is of steel, 1½″ diameter, and is geared to cut threads from 2 to 18 per inch. Compound rest is 7½″ wide and 18″ long. Weight with 8-foot bed 3,500 pounds. The lathe is, as the weight will indicate, intended for solid, hard work, and it is arranged for convenience of operation.




TWENTY-ONE INCH LATHE.

## Variations in Taper—Tenons.

BY JARNO.

After measuring the center shanks with a vernier caliper, and writing a list of the ten different rates of taper, then, in order to be sure that there had been no mistake, an angular gauge, Fig. 1 (page 2), was made, by fastening two parallels or straight edges *A A* to the piece *B* with the clamps *C C*. The three centers *F, D, E*, first tried showed up as in the Fig., the angle of *E* being less, and that of *F* more than *D*. The gauge was changed to fit *E*, and the rest of the centers were tried to see whether any had less angle than *E*. After a few trials the centers were ranged side by side, according to their respective rates of taper. There had been no mistake—the angular gauge agreed with the vernier caliper. A set of Jarno taper reamers and standards will shortly be presented to Waubug.

In a set of tapers it is not usually necessary to have the larger sizes vary, at the small ends, by a difference so little as one-tenth inch, which would be the variation if the numbers were taken in order. Numbers 13, 15, 17, 19, 21 and 23 can be omitted; have every number up to 12 inclusive, and higher than 12 have Nos. 14, 16, 18, 20 and 24. This set answers for every kind of machine tools in common use—lathes, drills, boring mills, milling machines. For some special tools perhaps one or two half number small sizes can be made, each size, of course, being derived directly from the number. For example, No. 2½ is .25″ diameter at the small end, 5-16″ at the large, and 1¼″ long. One line of tools may need but a few sizes of tapers. For twist drill shanks there is in use a set running by pretty long steps from ⅛″ to 2½″ diameter at the small ends. The Jarno tapers for twist drills are Nos. 3, 4, 6, 8, 10, 15 and 20. With some tool makers there is a tendency to make large tapers not so long in proportion as small tapers. Seldom if ever is there any need of varying the proportion. No. 24, which goes twelve inches deep in the spindle, may appear rather long for a milling machine, but it is not too long for an arbor that goes in a horizontal gear cutting spindle, and carries a seven foot gear. Should any variation be made, let the rate of taper remain the same; let the diameter at the small end correspond to same number of taper, the only variations being in the length, and in the diameter of the large end. Do not call any irregular shank by a number; name it by the diameter of the small end, and by the depth. If we commence to call irregulars by numbers, some of our old troubles will come back. We have had enough.

In addition to the gauge lately shown in the AMERICAN MACHINIST, it is well to have two standard plugs for each number. Keep one plug for reference only, and the other for a working gauge. The number and the year should be stamped upon each plug. One of the tendencies for which we must have a remedy ever ready is that which comes from a strong desire to try a piece by the reference gauge, when it does not fit the working gauge. To avoid any wear of the reference plug, which is sure to come if this desire is gratified, the plug should be out of reach of every one except the referee. As soon as a reference gauge begins to be used upon anything except to test other gauges, so soon do we begin to drift away from the standard. It is sometimes surprising to see how easily and how soon a standard may be lost sight of unless it be marked and guarded.

In establishing the sizes for tenons of twist drills, of milling and of other arbors, we must meet the requirements of two uses of tenons—one to prevent the slipping of the shank in the spindle, the other to back the shank out of the spindle. To prevent slipping, clearly the size of the tenon should be proportioned to the diameter of the shank in order to have the strength proportional. To back the shank out, the tenon for a small size must not be proportionately thin, and for a large size it need not be proportionately thick. It is also desirable that the backing keyhole through the spindle be not large. At best the keyhole is a weakener, taking away the tie between two sides of a spindle at a place where we can ill afford to have them untied. To meet these requirements the rule should add a constant in each size, so that the small shanks should have tenons thicker in proportion than the large. These limitations are not definite, neither are those for the length of the tenon.

Hence the following rules:

*Multiply .035″ by the number of the taper, and to the product add the constant .035″; the sum is the thickness of tenon.*

The thickness of the tenon of No. 1 taper is .07″. The tenon for No. 7 is seven times .035″ plus the constant .035″, or .28″ as in Fig. 2.

For the length of the tenon: *Multiply the number of the taper by .05″, and add to the product the constant .05″.* This is the length of the tenon beyond the part of the shank where the diameter of the small end is taken. For No. 7 taper, the length of tenon is seven times .05″ plus the constant .05″ or .4″ as shown.

Tenons are frequently made with an end mill, as indicated by the dotted line *H*, leaving its curvature at the inner end of the tenon, and going up into the body of the shank. The diameter of the mill can be twice the thickness of the tenon. The mill should be carried up until its center is the length of the tenon from the outer end.

The angle for beveling the end of tenon is the same as the rate of taper—one in twenty; that is, the bevels *G K* each make an angle, equal to the taper, with the line *I J* perpendicular to the axis.

The taper of the backing key should be one in twenty.

## Indicator Rigging for Compound Engines.

By Fred. W. Parsons, Elmira, N. Y.

*(A Paper presented at the New York Meeting of Mechanical Engineers.)*

It is sometimes interesting as well as instructive to combine the diagrams taken from the two cylinders of a compound engine.

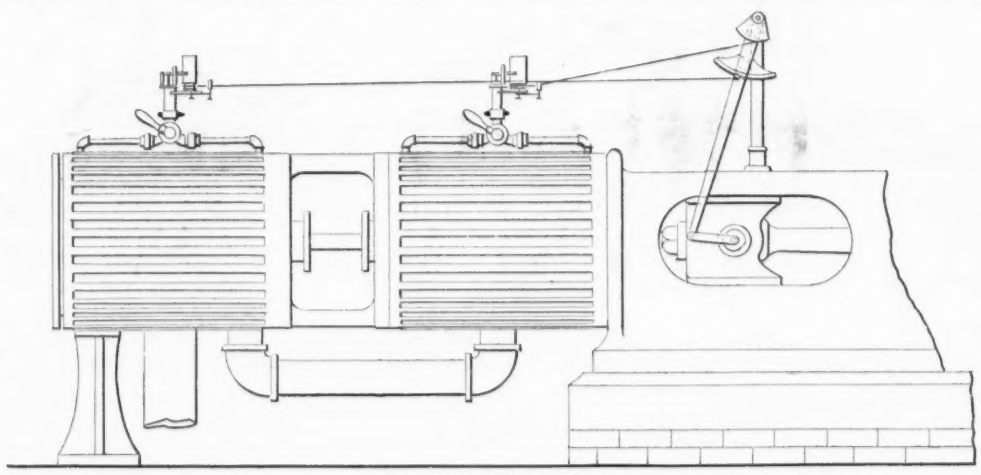
In order that the horizontal scale of measurements shall be the same, it is obviously necessary to reduce the high-pressure diagram to a length bearing the same proportion to the low-pressure diagram as the volume of the high-pressure cylinder is to that of the low-pressure cylinder.

The device described is an ordinary form of indicator rigging with two segments (as shown in the cut). The radius of the large segment is dependent upon the length desired for the low-pressure diagram.

The radius of the small segment is in the same proportion to the radius of the large segment as the volume of the high-pressure cylinder is to the volume of the low-pressure cylinder.

The diagram may be taken with separate indicators upon the high and low-pressure cylinders, as shown in the cut, and afterward traced upon the same paper; or by piping the high and low-pressure cylinders together with a three-way cock between, both diagrams may be taken on the same paper.

It will be readily seen that, by using three and four segments, this device can be used for reducing the diagrams from triple and quadruple expansion engines.



Indicator Rigging.

## Balancing Stationary Engines.

By W. H. Booth.

II.

For large engines of long stroke, and with piston speeds of 600 feet per minute, the rate of rotation is not great, and the transference of load or the shifting of the center of gravity of the engine is performed slowly, and does not coincide with the period of vibration of the foundation. In such engines there may be little or no need of any counterbalancing, especially when the rope or belt pulley is very heavy, and probably it is only necessary to consider the conveniences of running, and arrange a balance weight in the wheel in such position and of such weight as to render it easy to stop the engine at a point from which it will again start readily. In very large engines a standing balance may perhaps best be sought for in such engines; it is of no matter where the crank or cranks may be at stopping, for there is always now fixed a barring engine with automatic disengaging motion to help the crank off the dead points. In high-speed engines of short stroke, however, there is very rapid vibration of the center of gravity, and careful balancing is required. Many small engines running at a high speed use steam of great pressure, and consequently develop large powers; at 150 revolutions and a belt speed limited to 4,500 feet per minute, the diameter of belt pulley will only be 10 feet, but its width—for single thickness of belting—may be considerable. In such an engine or pair of engines most designers would aim to reduce all horizontal causes of disturbance to a minimum, and trust to solid foundations and good bearing caps to preserve vertical steadiness. Every designer must be the final authority to himself as to the quantity and quality of the balance he means to employ. Here we can only indicate the principles involved, and will suppose a pair of cylinders and an amount to be balanced of 100 pounds per crank, the cranks being plain without fans, and all balancing being done in the wheel. Merely for convenience we will suppose a distance of two feet from the plane of revolution of the disturbing force to the plane of revolution of the nearest part of the belt pulley convenient to receive a balance weight, and we will suppose four feet more to the same plane on the opposite side of the wheel; our conditions will then be as in Fig. 1.

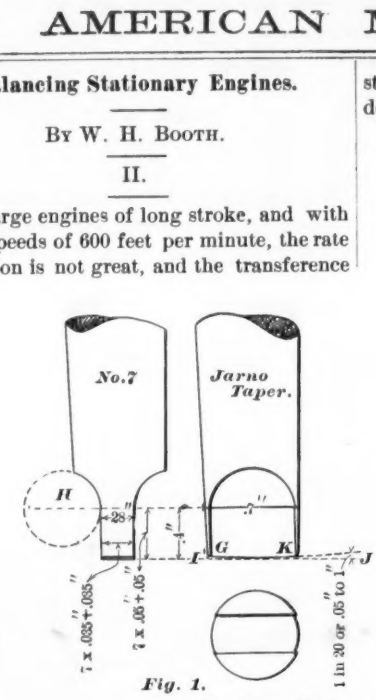



Fig. 1.

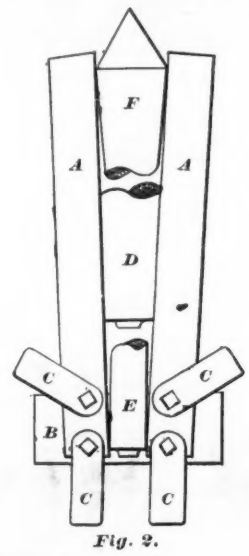
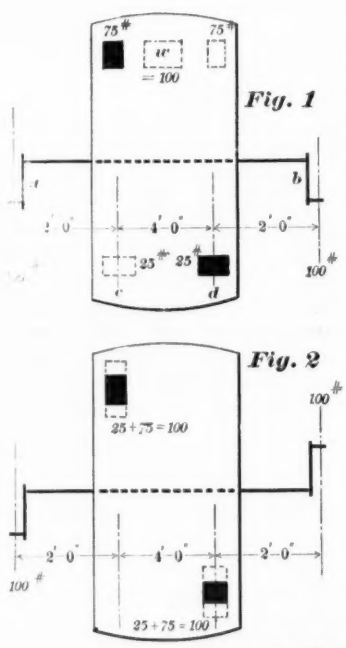



Fig. 2.

Tapers—Tenons.—See Page 1.



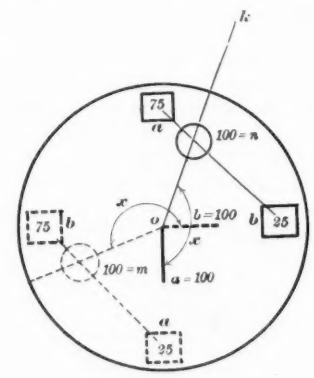




Fig. 3.

Balancing Stationary Engines.

Taking crank *a* first its disturbing weight has a moment about the plane *c* of 100 pounds x 2.0″ = 200 ft. pounds. We will suppose it to be balanced in the plane *d* by a weight whose lever arm about the plane *c* is 4′ 0″. Hence 200 ft. pounds ÷ 4′ 0″ = 50 pounds, which will be the weight required to revolve in the plane *d* at the same radius as the crank-pin. We will, however, place instead a weight of 25 pounds at a radius double that of the crank-pin. This weight will eliminate all torsional movements, but there will be an increased tendency to move to and fro in a direct longitudinal direction of the whole engine on its foundation. This is then exactly counterbalanced by adding a weight equal to the sum of the total disturbing weights, or 100 + 50 pounds = 150 pounds at crank-pin radius. Instead, however, we can place 75 pounds at double this radius, as in Fig. 1, to revolve in the plane *c* and opposite to the crank. If the disturbing weight of 100 pounds is supposed as entirely made up of the revolving weights at the crank-pin, and not to include anything of the weight of the reciprocating parts, such as piston, crossheads, etc., we shall have secured a standing balance of the engine, *i. e.*, it will stop equally at any point of the stroke. Many engineers are of opinion that nothing further is necessary to balance an engine, and that all the disturbing force of the piston, etc., ought to be taken up by suitable valve setting and adjustment of the rate of cushioning of the exhaust steam. Leaving this to the designer, there comes now the question of crank positions. First we will suppose both cranks to be on the same side, as in Fig. 1. Then crank *b* will require balancing exactly as crank *a*, but, as it were, cross-cornered on the plan of wheel as shown in Fig. 1, or with the weights of 75 pounds and 25 pounds as shown dotted.

We now see that each 75 pound weight is opposed by a weight of 25 pounds, and we at once remove both the smaller balances and may reduce the larger ones to 50 pounds. Still further we may use a single weight of 100 pounds in place of the two fifties, as shown at *W*. It is of course easy to arrive directly at this result without the foregoing steps, which serve to illustrate the process to be followed in complicated cases, such as Fig. 2, where the cranks are placed, as very frequently they are, opposite.

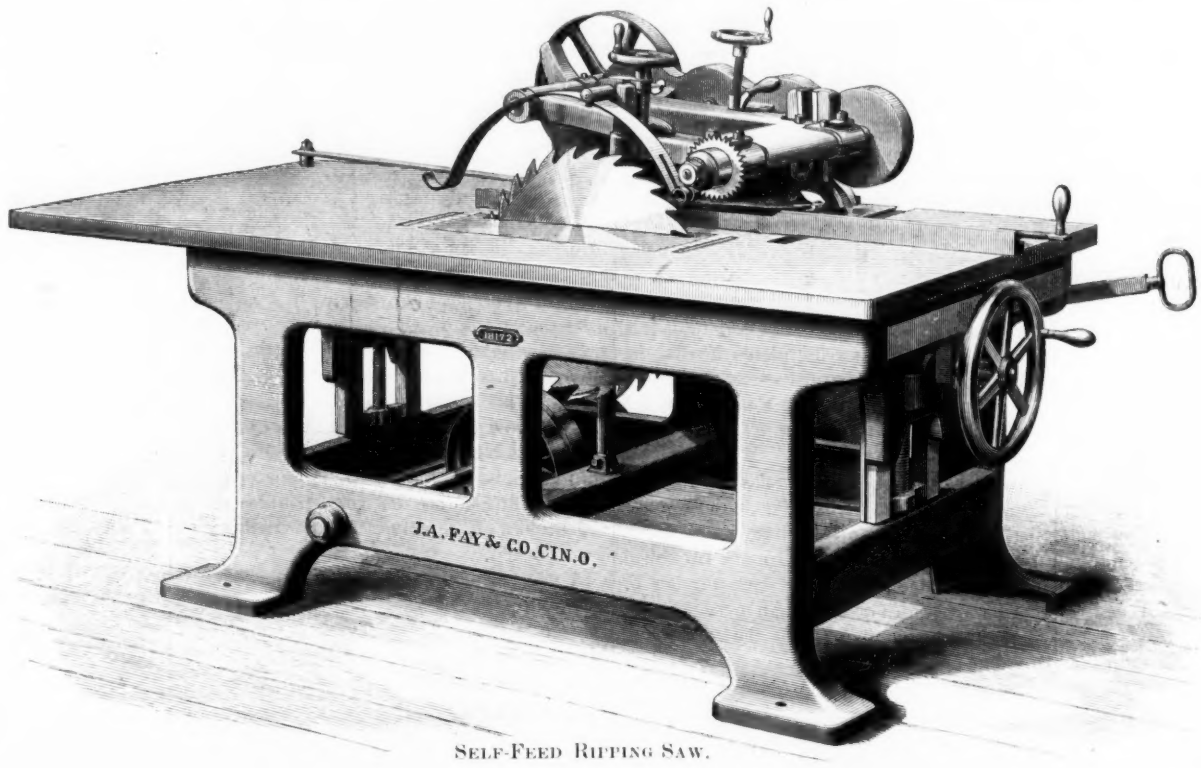
In this case the 75 pound weight for one crank will coincide with the 25 pound weight of the opposite crank, and similarly the 25 and the other 75 will coincide. In this arrangement two weights of 100 pounds each will be actually required placed in diagonal corners of the wheel in plan, and they cannot be replaced by any single weight. It has often been a matter of surprise to the writer that engine builders, who have objections to placing the cranks of compound engines at right angles with one another on account of the less favorable steam distribution thereby introduced, should so invariably place them opposite, as in Fig. 2, whereby they gain not one iota in uniformity of torsion over the method of Fig. 1, but introduce a complexity in the arrangement of balance weights, as well as doubling their weight, and for real accuracy placing them in a less sightly and dangerous position. If pistons must move stroke for stroke, they should move simultaneously and constantly in the same directions. The remarks immediately foregoing are worth the most consideration to those engineers who, while believing in simultaneously moving pistons, believe also in neglecting other than the *revolving* disturbing elements. When it is desired to balance pistons, etc., by weights disposed in the wheel, then the method of Fig. 2 has the advantage over that of Fig. 1, in that each counterbalance, whilst equilibrating its own engine in the horizontal plane, serves partially to balance the engine vertically also, and entirely balances statically; for when pistons and other *sliding* parts are balanced in the wheel the balance weights are of course heavier than the *revolving* disturbing weights by just the amount of the sliding disturbing weights sought to be balanced. Hence, if the methods of Fig. 1 were used in such a case the weight *W* would always be so much heavier than the cranks, etc., that it might cause an inequality in running, by its gravity. In method 2 the gravity of one weight counteracts that of the other, but there is introduced

a couple vertically, which alternately relieves and increases the crank pedestal loads, and tends to start transverse rocking of the engine, such as occurs in a locomotive on a too springing track.

There is, thirdly, the method of cranks at 90 degrees—perhaps the most usual method.

In this method, each crank is balanced as in method 1, but in place of being placed diagonally on plane, the four balance weights are obviously 90° apart on the circle, two of them on one side face of the wheel, and two as shown dotted in Fig. 3 on the other face, the weights being marked respectively *a a*, *b b*, for the two cranks *a*, *b*. Here the complexity of four weights appears, and our design should be to simplify this. Can this be effected? It is a principle of mechanics that any system of loads may be reduced to a single load acting at the mean center of gravity. The mean center of gravity of any two weights lies on a line joining the centers of gravity of the two weights, and at a distance from each inversely proportional to its relative mass.

Taking the two weights *a b* on the near face of the wheel, join them by a line as shown and divide this line into $75 + 25 = 100$ parts. Place a dot at the 75th mark from *b*, or, what is the same, at the 25th from *a*. Then a weight of 100 pounds, the joint weight of $a + b$, may be placed at this point and perform the same duty as *a* and *b*, which may be removed. Draw the radial line *o k*. Then the final single weight *n* may lie anywhere on this line *o k*, provided it be increased or decreased proportionately to its nearness to or distance from the center *o*. Similarly the single weight *m* will replace the two weights on the other side of the wheel, but no single weight can do duty for the two weights *n* and *m*, for they revolve in planes 4 feet apart. The angle *x* between the cranks, and the radius through the balance weights, will vary according to the various distances apart of the planes of revolution. In locomotives where the two balance weights for each crank are placed in two wheels, the distance of the plane of revolution of the near wheel is perhaps only one-twelfth (or less) the distance apart of the two wheels. Hence in locomotives the balance in the far wheel is quite small as compared with that in the near wheel, owing to its long lever arm—and the angle *x* may be about 165° properly balanced; therefore the counterweight in a locomotive is not exactly opposite the wrist-pin, but may be about 165° *before* it on one side of the engine and about 165° *behind* it on the other side, though they are often placed opposite the wrist-pins. This is a more serious error when the wrist-pins are long or the design is such as to place disturbing revolving weights far from their wheel. Stationary engine balancing is clearly a matter of judicious compromise between conflicting considerations, and cannot be carried out on any hard and fast lines, but must be wholly or partially effected in any one plane with special reference to the position in which the engine will be required to run, the kind of building in which it will be placed, and the necessity of a static balance or otherwise. All these points must receive proper consideration, or it cannot be expected that the results will be satisfactory.




SELF-FEED RIPPING SAW.

## Four-side Moulding Machine—Self-Feed Ripping Saw.

On this page we give illustrations of a newly designed "four-side" moulding machine, and a self-feed ripping saw table by J. A. Fay & Co., Cincinnati, Ohio.

The last mentioned machine is designed for ripping material into parallel strips, and for all ordinary ripping purposes. Owing to the regular and rapid rate at which the material is fed to the saw, the machine has proven very efficient, when compared with hand-fed machines.

The saw arbor is made of steel, is large in diameter, and mounted substantially in the frame of the machine in three long bearings. It is arranged so that several saws may be used at one time. The driving pulley on the arbor is placed between bearings outside the frame, and may be belted in any direction. It carries a saw up to 20″ in diameter.

The feed consists of a tooth disk acting on the top surface of the material, in line with the saw. It is driven by a train of strong gearing, which receives its power from a countershaft hung in the frame of the machine. The feeding disk and frame can be raised or lowered to suit material of different thicknesses, or thrown back out of the way, when the operator desires to do ordinary hand ripping.

The table is made of iron, very heavy, and raises or lowers parallel with the frame, being operated by the hand-wheel and screws shown. It is surmounted by a movable fence that is quickly adjustable across the surface of the table to suit the width of material to be sawed. Friction rolls are placed in the table just before and after the saw, to relieve the material of friction. Tables of wood instead of iron are furnished when desired, and there is also furnished to order, side-roll and bevel fence attachment for making siding. It can be set to any angle and any thickness, is simple and substantial, and can be quickly removed, leaving the table clear for ordinary work.

For shops which for any reason do not care to be at the expense of a regular re-sawing machine, this attachment offers an excellent substiute. The saw arbor pulley is 10″x8″, and should run at 2,400 turns per minute.

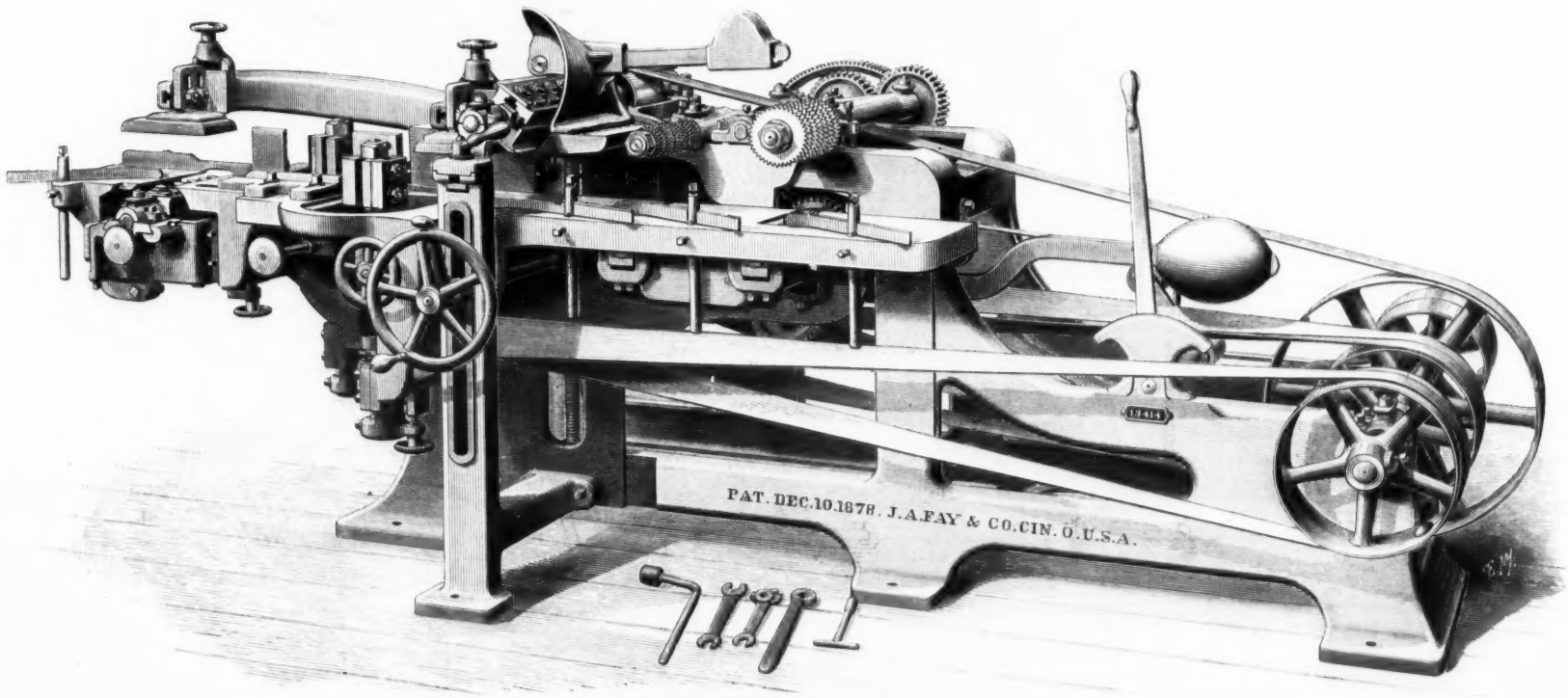
The moulding machine is built in two sizes to work material 8″ and 9″ wide, upon all four sides at once.

The heads have slotted faces to admit of the use of any kind of cutters with irregular slots. The under head as well as the side heads are mounted upon the bed or platen, and rise and fall with it, having an independent vertical adjustment to suit different work. The side heads have, in addition, angular adjustment, and can be moved laterally across the bed while in motion, from the working side of the machine. Adjustable mouth-pieces are fitted to the bed for reducing the size of the opening around the head, for fine and accurate work. An outside bearing, for supporting the outer end of the main arbor, and easily removed, is placed on an upright stand reaching to the floor and connected to the frame of the machine. This upright stand has a slot through which the rod for raising the bed passes, the rod being also used for clamping the bed in position.

The bed is gibbed to the frame, and raised and lowered by a hand-wheel at the side, in a convenient position to the operator, and where he is free from danger of contact with the cutters. The feed is of a very positive and powerful character, consisting of two spur or grooved rollers above, and two smooth rollers in the bed, all connected together and driven by a train of expansion gearing. The bed will lower and take in 16″ stuff without change in the gears. The upper feed-rolls are hung in swinging frames, and always raise parallel with the stuff being worked, and by simply raising the weighted lever they can be lifted from the work to stop the feed or allow the stuff to be withdrawn without stopping the machine.

The pressure-bar and bonnet are combined in one, and can be thrown entirely away from the upper head, permitting ready access to the cutters. Full sets of wrenches, springs, pressure blocks, etc., are sent with each machine.

The countershaft has tight and loose pulleys 10″x6″, and should make 1,000 revolutions.




FOUR-SIDE MOULDING MACHINE.

### Improvements in Exhaust Steam Feed-Water Heaters.

The accompanying cut shows some additional features of the Hoppes exhaust steam feed-water heater not heretofore shown. The manufacturers of this heater have sought to overcome what are considered objectionable features of open feed-water heaters.

The first of these objections is allowing the cylinder oil to get into the feed-water, and thence into the boiler; the second, the regulation of the water admitted to the heater, and the third, the liming up of the pump and feed-pipes, and the consequent trouble of pumping the water.

The first of these objections is provided against by placing a large oil catcher in the back end of the heater, into which the exhaust first enters before going into the heater proper. The oil is said to be thoroughly eradicated from the exhaust by this device, passing through the small pipe leading out of the back end of the heater, as shown in the cut.

The automatic water regulator consists of a float in the back end of the heater, which is connected to a valve in the inlet pipe *T*. The arm to which the float is attached is a pipe opening out to the outside of the heater, through the stem, passing through the back head, so that the float is always drained, and therefore cannot sink and become inoperative. This arrangement obviates all trouble of regulating the feed water.

The pans used in this heater are the same as used in the Hoppes live steam feed-water purifier, and as in that machine the lime is caught not only inside, but also on the *underside* of them. The large amount of lime-catching surface employed insures that all solids liberated at or under the boiling point will be retained by the heater, and the water made as pure as it can be made at that temperature.

The purified water from the heater cannot lime up the pump and pipe connections, and with a head of two feet or more on the pump it is readily handled.

It is claimed by the manufacturers of this heater that it has several advantages over closed or tubular heaters. The principal one of these is that about sixteen per cent. of the exhaust steam is condensed in the heater, and that amount of perfectly pure water saved. Another is that the heater affords a large expansion chamber for the exhaust steam, and the engine is relieved of any back pressure whatever.

The most important claim made for this heater over others, however, is that it will remove all the carbonate of lime, carbonate of magnesia, mud, sand, and all other impurities in water that are separated at or under 212 degrees Fah.

The manufacturers are the Hoppes Manf'g. Co., Springfield, Ohio.

### Straight Castings.

BY ROBERT E. MASTERS.

There are many reasons for castings becoming crooked or warped when cooling; if the pattern is out of proportion or has brackets and braces heavier than the plate, it is difficult to cast them straight. If the core for a column is not set and secured, so that the iron is evenly divided, the thin side will cool first and draw the column crooked; the manner in which the gates and runners are made has a great deal to do with making castings crooked. Some patterns are so poorly proportioned (it is oft-times necessary to make them so on account of fitting some particular place), that it is almost impossible to cast them straight; they will twist one way to-day, then, when you imagine you know just exactly how to overcome that, it will kink some other way to-morrow, and one will be put to his wits' ends to keep the unexpected twists and turns out of it.

What is already known of the causes and prevention of crooked castings would fill many chapters, and very likely that would not amount to one-half we do not know about the same subject. And we are often puzzled to find out the cause of crooked castings, as witness the trouble and worry Mr. Thomas Keenan had in casting a lot of sewing machine plates $14'' \times 7'' \times \frac{3}{16}''$ straight, before he found out the reason for their being crooked, an account of which is in the AMERICAN MACHINIST of August 6th, 1887.

Sills, lintels, etc., etc., for house work, are somewhat troublesome to make, on account of the flanges and ribs frequently being heavier or lighter than the main body of the casting, and unless they are carefully moulded and cared for after being cast, they are apt to be more or less warped.

It is advocated by some who have had considerable experience in casting long, thin plates, that "sawing partly through and across the center of the pattern, so as to let the ends drop down when moulding it the same distance it will spring up when it is cast, will produce a perfectly straight casting." Others claim it is best to "make the pattern concave sufficiently to become straight when the plate is cold." One gentleman told me, when he has long narrow plates to cast, he "wedges under the center battens of the bottom board, so as to spring the flasks up and let the ends hang down as much as the plates will crook up."

When bottom boards or flasks are used for any character of work, it is better to have them resting firmly on the floor, but it is not always that they or a pattern are furnished to mould a plate. If there are a number of plates to cast off one pattern, experience may teach just how much to let the ends hang down or how much of a concave to put in a pattern.

I have had some correspondence on this subject with an ex-foreman of B. F. Sturtevant's Blower Works foundry. He says: "In casting sides for blowers, 9 feet high, I had to cut the pattern in the center and let it drop down at the ends as much as it would spring up; but experience taught me just how much to let the ends drop; to run the mould I cut a channel all around it, just the same as if it was to be poured with one ladle. I then cut a number of thin broad gates from the channel into the mould, and poured the iron in at four sprews, cutting short as soon as it showed in the riser, and as soon as I could, I broke the gates off."

This will do very well on a regular run of work with a standard mixture of iron, but I would give considerable to know just how to apply this rule in case there is an order for a dozen plates of various lengths, widths and thicknesses, ranging from 8 feet to 30 feet long, 13″ to 24″ wide and $\frac{5}{16}''$ to 3″ thick. I confess my ignorance of how any table of this kind could be established so that it would work correctly in all shops alike. If it was not for the shrinking and contracting of iron we would have comparatively little trouble with any class of castings, but that is one great drawback that must be considered in this case. About the time experience had taught how much to bend the pattern to suit one mixture of iron (even where a number of plates were to be cast from the same pattern) the character of the pig or scrap in the mixture is liable to be changed, which would give altogether different results.

There is not much that can be done towards following any set plan; no fixed rule will do for all cases. It is just simply a character of work, where a man has to exercise intelligence, studying into the cause of the trouble, to find and apply the remedy. If it is a pattern that is poorly proportioned, the heavier parts ought to be cooled off, and the thin parts kept hot, so that the casting is brought to about the same degree of heat all over, and allowed to cool off in that manner to prevent cracking. It is not unfrequently the case that parts of the casting are so heavy that they have to be cooled off with water, as referred to in the AMERICAN MACHINIST of March 26th, 1887.

STRAIGHT CASTINGS.

A narrow plate 6 feet to 10 feet long, $\frac{1}{4}''$ thick, that is gated along one side with broad, thin gates, is very apt to crook sidewise by the gates cooling before the casting, unless they are broken off shortly after the casting has been poured.

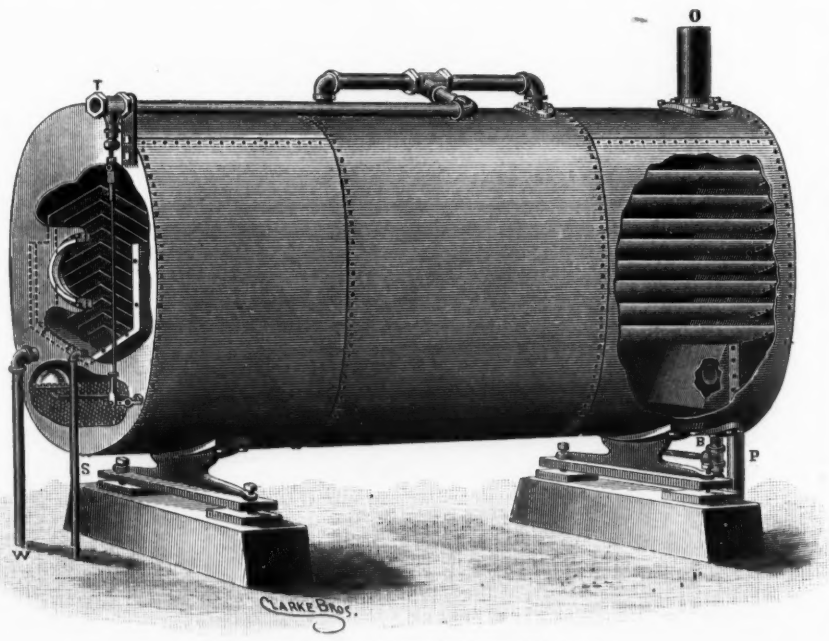
A number of these plates, and a large order of long, straight gear segments and racks were cast straight by elevating one end of the flask, and pouring them from the high end, breaking off the gates as soon as possible and letting them remain in the flask with the cope on until cold. An order for over 3,000 very thin plates, 16″ long, and 7″ wide, was filled without one of them being condemned on account of warping. As soon as they were cast they were shook out, the gates knocked off, and the castings stood up on edge.

It is curious to see what foundrymen will resort to at times in their anxiety to keep a piece of work straight. I remember seeing a plain plate cast, 12 feet long, 3 feet wide and $1\frac{1}{4}''$ thick, with a 12″ hole in the center of one end 4″ from the edge. As soon as it would stand handling a chain was put through the hole in the casting, and the plate swung from a crane. Another foundryman, who had some long thin sills to make used flasks with iron cross-bars over the ends and center of the casting. As soon as the sills were cast he dug down at the ends and center, and while the castings were yet red, put iron wedges between the plate and the iron cross-bars, filling up the places again; the flask was left clamped to the bottom board.

It is a common thing to see moulders scrape the sand off clean from the center of a plate *on top*, and then weight the ends down; by exposing the center of the top of the casting it will cool off more rapidly there than at any other part, and in contracting will have a tendency to draw the ends up, unless the weights are heavy enough to hold them down. If any one wishes to experiment on this, let them cast a plate long enough to test the matter, and cool it off in the center on top with water. The heat will naturally escape through the sand in the cope from the top of the casting first, leaving the bottom still hot, and it would look more reasonable to dig the sand out from *underneath* the center of the casting and weight down the ends.

Some time ago we had some angle plates to cast, as shown in the sketch. They were 18 feet long, 20″ wide, 7″ deep at the angle and 1″ thick all over. There was nothing important about their being exactly straight, and, as an experiment, when the first one was cast the sand was rapped out of the cope on top of the casting, and scraped off the center for the space of 3 feet on top. This casting was sprung like the dotted line *A*, and was $\frac{3}{8}''$ higher at the ends. The next one we reversed this plan, kept the top well covered up, and dug out underneath the center 3 feet long. These plates came out straight enough for anything.

We cast some plates 12″ wide, 20 feet long and 2″ thick, and several 28 feet long, 20″ wide and 3″ thick, to which we paid no particular attention after casting; they seemed to keep straight from their own weight.



EXHAUST STEAM FEED-WATER HEATER.

### Modern Locomotive Construction.

BY J. G. A. MEYER.

ONE HUNDRED AND FIFTH PAPER.

Spring gears, such as we have illustrated in our last paper, cannot be used in many narrow-gauge engines, because in these engines the width of the fire-box is generally made so great as to leave insufficient room for the springs between the fire-box and the driving wheels. Figs. 607, 608 (page 5) show a portion of a general plan of an eight-wheeled passenger engine, 3 feet gauge; the spring gear is plainly shown, and besides this, the design and arrangement of other details are given, which we shall first describe very briefly, as we believe they will be interesting and instructive to the reader. The ash-pan *A* here shown is made of sheet-iron. In order to obtain a sufficient grate surface, the width of the fire-box *B* is such as to cause the reduction of the width of those portions of the frames *F* which lie alongside the fire-box, the lower brace of the frame remaining the full width throughout. This class of frames we have called "slab frames," and have been illustrated in Figs. 298 and 299 (fifty-second paper). *C* is the rear damper handle; *E* the rigging for the front damper handle; *G* the pads, securing the frames to the boiler, and yet allowing the boiler freedom for expansion; *H* the foot plate; *I* the injector; *J* the drawbar; *K* the lever for shaking the grates; and *L* the reversing lever.

For the spring gear two equalizing levers are placed on the top of each driving-box *O*, the equalizing levers $M_2$ on the front box are connected to the spring hanger $P_5$; this spring hanger is of the **T** form, its upper branches forming hubs taking up the space between the two equalizing levers, the whole being connected by a pin about $\frac{3}{4}$ of an inch in diameter; the lower end of the hanger $P_5$ passes through a slot cut in the brace of the frame, a spiral spring is placed between the bottom of the frame and the gib, passing through the lower end of the hanger. The other ends of the same equalizing levers are connected to the spring hanger $P_4$. The form of this hanger is shown in Fig. 609. The jaws *a a* are connected to the levers, and the lower end takes hold of the spring. The other end of the spring is connected by means of the hanger $P_1$ to the equalizing lever *N* below the frame; the form of the spring hangers $P_3$ is shown in Fig. 610. The lever *N* works on the pin *Q* shown in Fig. 611; the holes drilled in the boiler pad *G* and the plate *D* form bearings for the pin *Q*. A pin or roller *b* is inserted between the spring and spring seat *c*, as shown in Fig. 612. The equalizing levers on the rear box, and spring hangers for the same are like those we have just described. All the boiler pads extend to and

are fastened to the lower brace of the frame, so as to strengthen the latter and enable it to carry the weight thrown upon it.

Now let us return to the spring gear shown in Fig. 599 (last paper), and find by calculation the depth of the equalizing lever *E*.

*Example.*—Find the depth of an equalizing lever for a 17 × 24 inch eight-wheeled passenger locomotive; the thickness of the lever is to be 1¼ inches; the distance from the center of the spring hanger *B* to the center $B_2$ is 60 inches. In table 5 (fifth paper) we find that the weight on the drivers for this class and size of engine is 52,020 pounds. From this weight we must subtract the weight supported directly by the track, such as driving-wheels, axles, etc., as stated in our last paper.

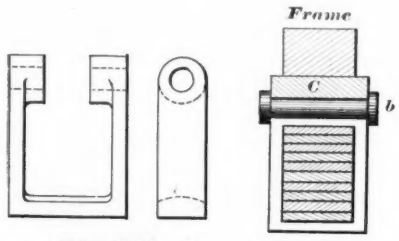


*Fig. 610*




*Fig. 612*

Supposing the total weight to be subtracted (that of four driving-wheels, two axles, four driving-boxes, etc.,) amounts to 12,000 pounds, we then have 52,020 — 12,000 = 40,020 pounds to be supported by four springs; hence each spring will have to support

$\frac{40,020}{4} = 10,005$ pounds. Since the load which the equalizing lever has to support is equal to one-half of the sum of the loads on two springs (neglecting that part of the load which is due the weight of the springs), we may say that the total load on the lever is equal to 10,005 pounds, and since the length of the equalizing lever is measured from center to center of the spring hangers, we may consider the equalizing lever to be a simple beam having a rectangular cross-section; the beam is freely supported at the ends; its thickness is 1¼ inch, length 60 inches, and loaded at the center with a weight of 10,005 pounds. It is now required to find the depth of this beam. In books treating on the strength of material we find the following equation for a beam of this kind, and loaded under the foregoing conditions. $\frac{1}{4} W l = \frac{1}{6} f b d^2$, in which *W* represents the load in pounds; *l* the length of the lever in inches; *f* the stress in pounds per square inch on the outer fibers of the lever, that is, the fibers running lengthways of the lever; *b* the breadth of the lever in inches; and *d* the depth of the lever in inches at the center. Usually for *f* a value of 12,000 pounds is assigned, so that our equation will read: $\frac{1}{4} W l = \frac{1}{6} \times 12,000 \times b \times d^2$; this equation may be reduced to

$$W l = 8,000\, b\, d^2.$$

Hence to find $d^2$ we have

$$\frac{W l}{8,000 b} = d^2;$$

substituting the numerical values for the symbols, we obtain

$$\frac{10,005 \times 60}{8,000 \times 1\frac{1}{4}} = d^2 = 50.02,$$

which, as will be seen by the symbol $d^2$, is the square of the depth of the lever at the center. Consequently, to find the depth *d* we extract the square root from 50.02, or

$$d = \sqrt{50.02} = 7.07 \text{ inches},$$

which is the depth at the center of the equalizing lever.

From the foregoing we may establish the following

*Rule.*—To find the depth at the center of an equalizing lever for an eight-wheeled passenger engine. Subtract from the weight in pounds on the driving-wheels, that portion of the weight which is directly supported by the rails; divide the remainder by four; the quotient will be the load at the center of the equalizing lever. Multiply this load by the length of the lever in inches, and call the result, product *A*. Multiply the breadth in inches by 8,000, and call the result, product *B*. Divide the product *A* by product *B*, and find the square root of the quotient; the result will be the depth at the center of the equalizing lever.

If there is a notch cut across the lever, so as to form a bearing for the gib in the fulcrum, as shown in Fig. 561 (last paper), the depth found by the foregoing rule will be the distance from the bottom of the notch to the bottom of the lever.

If the lever has a uniform breadth, and tapers uniformly towards its ends, as shown in Fig. 561, the depth at the ends should be equal to one-half of that at the center. This proportion will give us an equalizing lever which is at no place weaker than at the center.

It would seem that the thickness of the metal at the sides of the slots cut through the lever should be equal to one-half of the thickness of the solid part of the lever; but practice seems to indicate that better results are obtained by increasing it about 15 per cent.

The lever shown in Figs. 561 and 562 was made for a 17x24 inch eight-wheeled engine. Comparing the depth given in these figures with the results of our calculation, we find that the latter call for a greater depth. The reason for this difference is twofold: first, the weight on the drivers under the engine, for which the lever in Figs. 561, 562 was designed, was less than the weight taken in our example; second, unless the lever was made of the best quality of wrought-iron, such as is not generally used for equalizing lever, the lever shown in Figs. 561, 562 is not strong enough.

If for any reason the depth of the equalizing lever is limited, compelling us to find thickness instead of the depth of the lever, we may use the following formula:

$$\frac{W l}{8,000\, d^2} = b.$$




*Fig. 609*

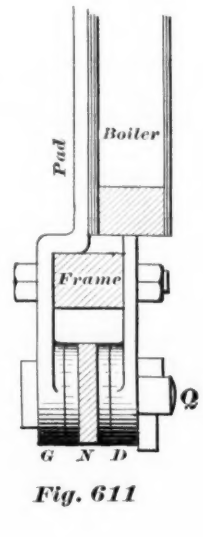



*Fig. 611*

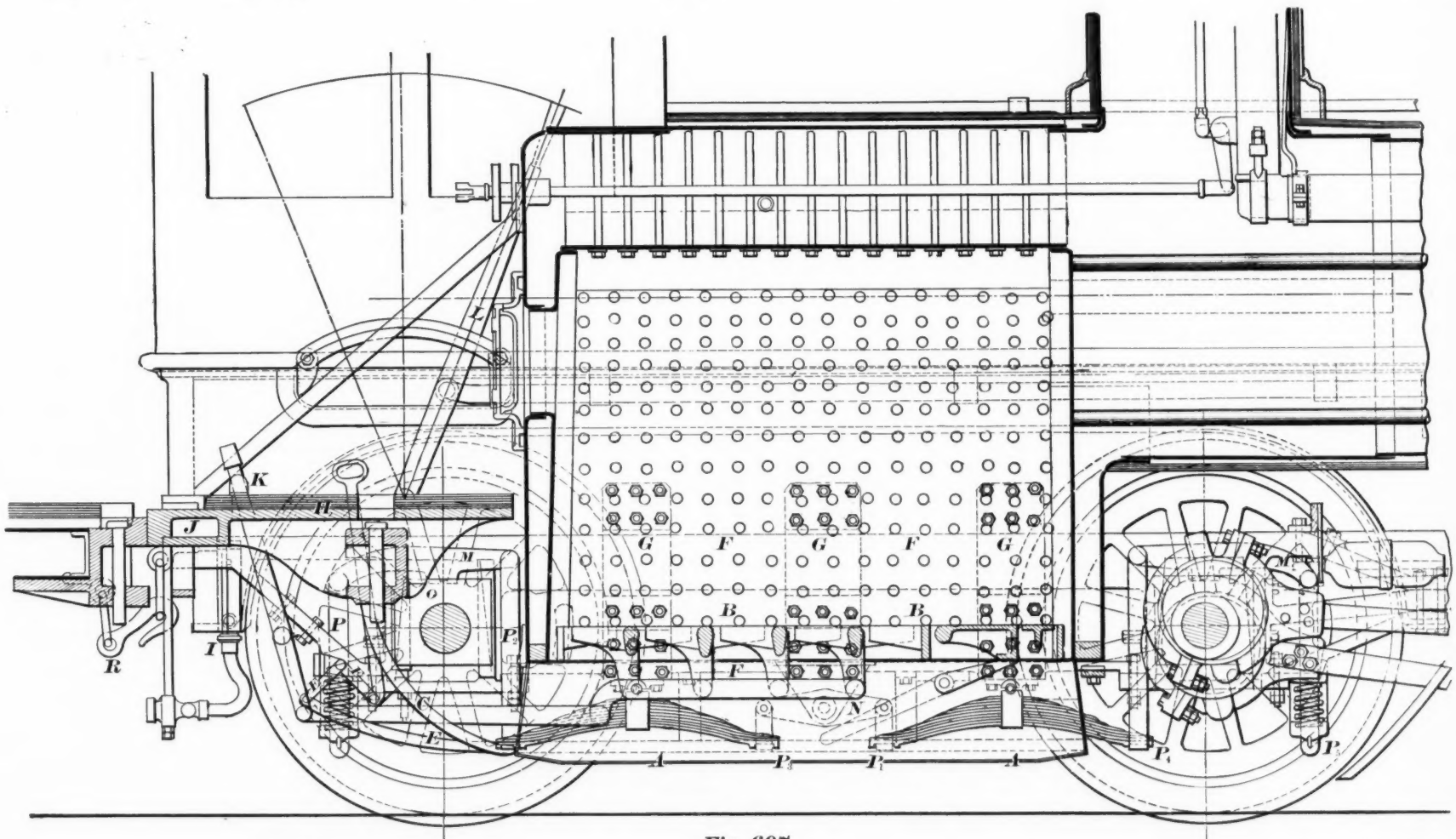



*Fig. 607*

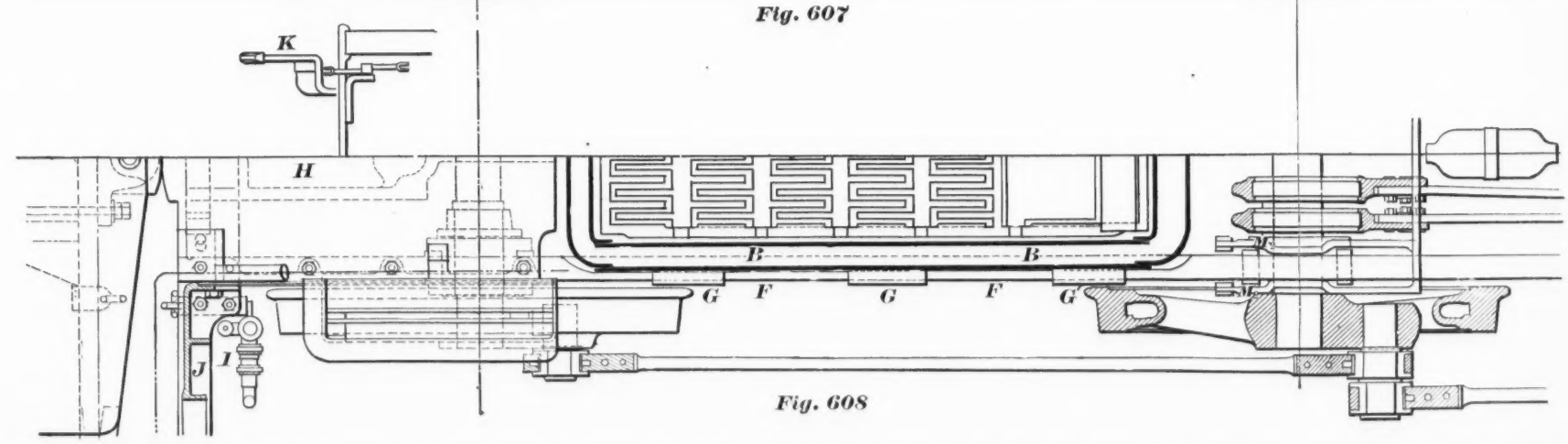



*Fig. 608*

## LETTERS FROM PRACTICAL MEN.

### Table of Angles.

*Editor American Machinist:*

Having occasion to do a good deal of work in dividing or spacing of circles into equal parts, I find that a table of angles, in a convenient place to glance at, is of considerable value in helping to expedite the work.

As every draftsman has more or less of this kind of work to do, the following table of angles, written or printed on a small card of convenient size, will be—with the use of the protractor—of service to him by saving time in calculating the angle, or spacing around the circle with a pair of dividers.

In many instances this table would also be useful to machinists and pattern makers who have use of protractor.

TABLE OF ANGLES.

| Angle at center. Degrees. | Number of equal parts of circumference. | | Angle at center. Degrees. |
|---|---|---|---|
| 120 | 3 | 12 | 30 |
| 90 | 4 | 13 | $27\frac{9}{13}$ |
| 72 | 5 | 14 | $25\frac{5}{7}$ |
| 60 | 6 | 15 | 24 |
| $51\frac{3}{7}$ | 7 | 16 | $22\frac{1}{2}$ |
| 45 | 8 | 17 | $21\frac{3}{17}$ |
| 40 | 9 | 18 | 20 |
| 36 | 10 | 19 | $18\frac{18}{19}$ |
| $32\frac{8}{11}$ | 11 | 20 | 18 |

The table can be carried out further if desirable. N. M. BAKER.

### The Decimal System.

*Editor American Machinist:*

With respect to the decimal system I would suggest that, by making an American meter equal to $31\frac{1}{4}$ inches, a millimeter would be $\frac{1}{32}$ inch, which is the smallest binary division of the inch used to any considerable extent. $\frac{1}{64}$ and $\frac{1}{128}$ inch would become .5 and .25 mm. respectively. All of our foot and inch measurements could be exactly expressed by such a system, and therefore all existing drawings, tools, etc., would be available without change. The unit would be the millimeter, or $\frac{1}{32}$ inch. Old designers could think in inches and feet as they are used to, but figure their drawings in meters and millimeters.

Engineers, draftsmen and mechanics could use scales or rules with a single set of lines, but two rows of figures, one reading inches and the other millimeters, so that an old drawing or tool could be measured by the new system or *vice versa* without difficulty.

All of our standard sizes could be maintained under a simple change of name. Taps of $\frac{1}{4}$, $\frac{5}{8}$ and $\frac{3}{4}$ inch diameters would come to be known as 16, 20 and 24 millimeters. $1\frac{1}{16}$, $2\frac{7}{16}$ and $2\frac{15}{16}$ shafts would be 62, 78 and 94 mm.

The following is a table of equivalents:

| | Written. | Equal to. |
|---|---|---|
| Meter | 1.000 | $31\frac{1}{4}$ inches. |
| Decimeter | .100 | $3\frac{1}{8}$ " |
| Centimeter | .010 | $\frac{5}{16}$ " |
| Millimeter | .001 | $\frac{1}{32}$ " |
| | .0005 | $\frac{1}{64}$ " |
| | .00025 | $\frac{1}{128}$ " |

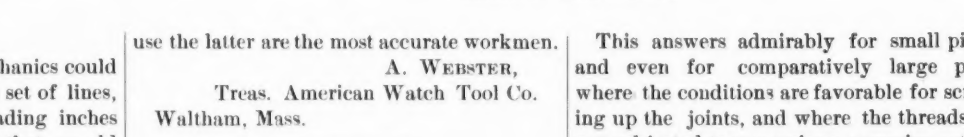
It is not necessary that our unit be the same as the French unit, and it is very certain that our manufacturers will oppose by every means in their power any change which would necessitate the abandonment of costly tools and machinery, but it is very desirable that we should avail ourselves of the convenience of the decimal system when the expense involved can be restricted to hardly more than the cost of new rules and scales. E. D. MACKINTOSH.

### Holding Crossheads.

*Editor American Machinist:*

Enclosed herewith I hand you for publication a sketch of a device for holding two crossheads on the planer, thereby making two grow where we usually find but one.

I do not know that this device is new. However, I do know the idea is not in general circulation, and that it is a good thing—the sketch will convey sufficient idea of the apparatus, therefore no written description will be necessary. C. O. D.

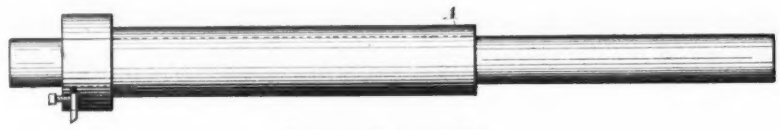



HOLDING CROSSHEADS.

### Sleeve Boring Bar.

*Editor American Machinist:*

Enclosed find cut of a boring bar for straight or taper work. The bar is held between the centers. Fasten a dog at *A*, clamp a tool in the tool-post, run it up to the dog and put on the feed. The sleeve should be an easy fit on the bar. E. W. THURSTON.



SLEEVE BORING BAR.

### Lathe Centers.

*Editor American Machinist:*

Many years since I found interchangeability of lathe centers of such value that I changed all the lathes of the American Watch Co. to one standard, and afterwards, in ordering lathes, specified, "Center tapers to our standard," and also treated screws for face plate in the same way.

In my own factory, where we have thirty lathes, all tapers and face-plate screws are alike.

We are not able to make live centers in the tool-room so they will run true in all lathes.

On "decimal measurements" would say for forty years I have used hundredths of an inch as a working measure, and for the past twenty years have used hundredths of a centimeter, and on extra fine work like ours would use the latter every time, for I know by long experience that workmen who do use the latter are the most accurate workmen.

A. WEBSTER,
Treas. American Watch Tool Co.
Waltham, Mass.

### Indurated Fiber for Friction Surfaces—Annealing Steel.

*Editor American Machinist:*

There is one make of shaper, much used in Connecticut, the reciprocating motion of which is obtained by means of a friction clutch working between the pulleys, which run in opposite directions.

Four bosses on this clutch form the points of contact with the pulleys, and as all these surfaces are of cast-iron, they will cut if not oiled, and if oiled will slip, so we changed the clutch in this manner: cutting away the bosses on the clutch, we fitted pieces of indurated fiber in their place. The result has been so satisfactory that we thought it might be of benefit to some one else using the same kind of machine.

One thing more. All notes on annealing steel, that I ever have read, direct us to cool as slowly as possible, to obtain the wished-for softness. Now, all steel workers know that there is a point but little below a red heat, at which point, if the metal be then quenched in some liquid like soapsuds, the results are equal if not superior to those produced by the slow process.

Can any of the men who are "way up" on steel, tell us anything why such treatment should produce effects seemingly at variance with the accepted rules for annealing? A. W. PARKHURST.

Bristol, Conn.

### Screw for a Press.

*Editor American Machinist:*

Noticing the inquiry of J. R. G., Question 406, I would say that, having used both compound and fine-thread screws in four-inch shaft straighteners, I am confident that a three-inch soft steel screw, four pitch in a nut not less than six inches through, will be most satisfactory. The thread should be square on the face, and 45° on the back side, and flat on top and bottom $\frac{1}{32}$ of an inch.

JAMES H. WELLS.

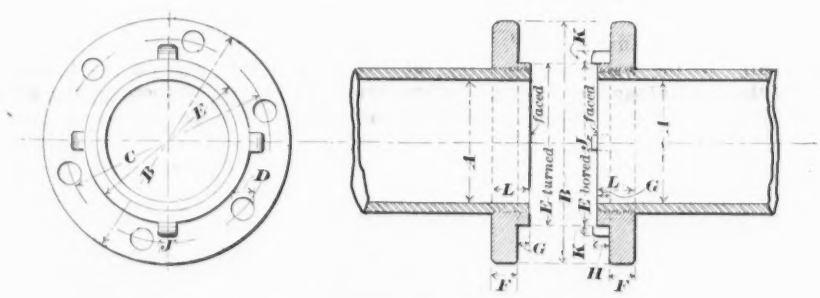
## Steam Pipes for Collieries.

BY E. F. C. DAVIS, POTTSVILLE, PA.

*(A Paper presented at the New York Meeting of Mechanical Engineers.)*

The most common and the cheapest method of carrying steam, taking the world at large, is probably through wrought-iron "gas pipe" joined by the taper thread, screwed into sockets or ferrules.

This answers admirably for small pipes, and even for comparatively large pipes where the conditions are favorable for screwing up the joints, and where the threads are not subjected to any serious corrosive action. Many of the steam pipe lines in the anthracite coal regions, however, run for great distances underground, through contracted slopes and headings, where it is almost impossible to make the screwed joint. In the screwed socket joint there is always some space between the ends of the pipes, and the condensed steam from the best available feed water is so corrosive that a cutting or furrowing action takes place between the ends of the pipes and the ferrule, which sooner or later causes leakage. It is then impossible to tighten up these screwed joints without screwing up the whole pipe line.




STEAM PIPES FOR COLLIERIES.

Some of these difficulties are avoided by the use of "flange unions." With these the pipe line can be more conveniently put together underground, and in the event of a leaky thread the flange can be screwed on tighter, or a defective pipe can readily be replaced by a new one of the same length. But in the ordinary flange union there is a space between the ends of the pipes, and the above-mentioned corrosive action is so destructive to the threads that cast-iron pipes have generally been considered necessary for reliable and durable steam pipe lines; though the first cost is about double that of wrought-iron pipe.

In view of the foregoing, the Philadelphia & Reading Coal & Iron Co. has adopted the flange joint shown in annexed cut, for all colliery steam pipes. These flanges are screwed tightly on the pipe—the pipe carried in a steady rest—and the end of pipe and flange faced off flush with each other. The lugs are at the same time bored out, and the projection turned off concentric with the bore of the pipe. This insures perfect continuity in the pipes, and the lugs also center the gum-joint rings accurately, so that a gum-joint is obtained between the abutting ends of the wrought-iron pipes. The continuity of the bore of the pipe insures a free flow of steam and condensed water, so that all liability to furrowing at the joints is avoided, and the gum-joint formed between the ends of the wrought-iron pipes protects the thread from all danger of corrosion. If an odd length of pipe needs to be made at a colliery, the pipe—if not over four inches—can be threaded with a hand-stock and die, and a finished flange screwed on until the pipe projects through. The pipe must then be filed off flush with face of flange.

In moulding these flanges it is best to have the pattern arranged to leave its own cores. This insures accuracy in the positions of the bolt-holes and the large central hole, relative to each other and to the other parts of the flange.

Several thousand feet of steam pipe fitted with these flanges have been put in service, and have all proved perfectly satisfactory.

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Now, if a man go to Paris, and have any sense, he goes across the river, into a book-store, and they give him for five cents a little programme, which tells him of a hundred and twenty or more lectures which the first men in France are delivering day by day, in one of the great institutions of France. This five cents is all that the traveler pays for the right of hearing any of these lectures. They are the lectures of men to men—of educated men to educated men. In this way you may hear Brown-Sequard, or Simon, or Renan, telling the best he knows to-day on the subject which interests him to-day, and which has made him a leader in his line.

There is nothing akin to this now in the United States; you can go into the Senate chamber and hear Mr. Sherman or Mr. Hoar, you can go to a congress of archæologists, of philanthropists, of physicians, of engineers, and hear a man talk as he talks to men, but, with the single exception of Johns Hopkins University, there is nothing as open as this University of France to anybody who, any day, may wish to learn what he can from a first-rate authority. I suppose that Clark University hopes, as time goes on, to do something on such lines. — From "Tarry at Home Travel," by Edward E. Hale, D. D., in the *New England Magazine* for November.

## Twentieth Meeting of the American Society of Mechanical Engineers.

The professional sessions of this society were held in the Academy of Medicine, New York City—the first one occurring on Tuesday morning, November 19th. Among the general business considered by the society, the following proposed amendment, as presented at the Erie meeting, was adopted.

PROPOSED AMENDMENT TO THE RULES OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

ARTICLE 20.

The affairs of the society shall be managed by a council, consisting of a president six vice-presidents, nine managers, and a treasurer, who shall also be the trustees of the society.

All past (ex) presidents of the society, while they retain their membership therein,

shall be known as honorary councillors, and shall be entitled to receive notices of all meetings of the council, and may take part in any of its deliberations; they shall be entitled to vote upon all questions, except such as affect the legal rights or obligations of the society or its members.

ARTICLE 21.

The members of the council shall be elected from among the members and associates of the society at the annual meetings, and shall hold office as follows:

The president and the treasurer for one year; and no person shall be eligible for immediate re-election as president, who shall have held that office for two consecutive years; the vice-presidents for two years, and the managers for three years; and no vice-president or manager shall be eligible for immediate re-election to the same office at the expiration of the term for which he was elected.

President Towne, in his address, spoke of the visit of the engineers to Europe, and of the remarkably cordial manner in which they were received. The latter part of the address related to the proposed world's fair. He spoke enthusiastically in favor of New York as the location, but he thought that the time for holding the fair should be extended one or two years.

A paper prepared by V. Dwelshauvers—Derz on the properties of steam, was presented.

In the discussion which followed, one of the members said that he could not see anything new in it, and that he considered the tables published by Prof. Peabody to be superior.

Prof. Thurston, who presented the paper, explained that the author had recently given much attention to the study of the exchanges of heat occurring in the cylinder of the steam engine, and that the paper interested him much, and he thought it would be of interest to others.

In the paper on Chimneys, by H. B. Gale, the author concluded that the theory promulgated by Peclet, Rankine, Morin and Weisbach, and generally accepted by modern writers, contains certain errors, on which have been based conclusions and formulas which are not supported by the results obtained in practice.

In the discussion which followed, Prof. Denton and Mr. Kent did not agree with the author's conclusions. Prof. Denton insisted that the formulas given by Rankine are correct for practical purposes.

Prof. R. H. Thurston presented a paper relating to the philosophy of the multi-cylinder or compound engine, its theory and its limitation.

In the discussion which followed, Prof. Denton expressed regrets that the author did not give practical data or facts to prove the usefulness of steam jackets as stated in the paper.

Mr. Ball said that the experiments made by him did not agree with the results given by Prof. Thurston.

The afternoon session opened with the reports from the tellers on the election of officers. The following officers were elected: President, Oberlin Smith, Bridgeton, N. J.; vice-presidents, Joel Sharp, Salem, Ohio; Geo. W. Weeks, Clinton, Mass.; De Volson Wood, Hoboken, N. J.; treasurer, William H. Wiley, N. Y.; managers, Jas. E. Denton, Hoboken, N. J.; Carlton W. Nason, New York; H. H. Westinghouse, Pittsburgh, Pa.

On Wednesday, a party, composed of about two hundred ladies and gentlemen, visited the United States Station situated on Willet's Point, L. I., and were much interested in the progress of the art of modern warfare. It may be said that the station at Willet's Point is almost an advanced engineer's school, where the young engineers graduating from West Point are sent for a course of engineering instruction, particularly in relation to torpedo work.

On the way back to the city, the party stopped at Whitestone and visited the Central Forge Works.

Judging from expressions heard, no visit of the Society was better enjoyed than this one on Wednesday.

At Thursday's session, President Towne presented measures for forming a new organization of engineers, which would not disturb or supersede those already in existence, but will be broader and more comprehensive, or more representative and national in character. The discussion ended by resolving:

*First*—That the American Society of Mechanical Engineers views with favor all efforts tending to establish more intimate relations between the existing engineering societies, and to develop a national organization of American engineers.

*Second*—That, to promote this object, the council be hereby requested to communicate these resolutions to the officers of other engineering societies, and to invite them to unite in a discussion of the subject, and in an endeavor to reduce it to proper form for submission to the consideration of the membership of each society.

*Third*—That to this end the council be further requested to appoint a committee of three members, to represent this society in any such conferences to consider the whole subject herein referred to, and to report the result of their labors to the next meeting of the society.

The reading of professional papers was then resumed. The first paper related to the Indicator Rigging for Compound Engines, by F. W. Parsons. In the discussion, it was pointed out that this rigging will reduce the diagrams to such an extent, as to make it difficult to measure them accurately, particularly in compound engines, in which more than two cylinders are used. The inaccuracies caused by the stretching of the chord were also referred to.

In the discussion which followed the reading of C. T. Main's paper, on the Cost of Steam and Water-Power, Secretary F. R. Hutton read notes sent in by Samuel Weber, as follows:

I desire to offer, as a part of the discussion on Mr. Main's paper, the following notes, which were prepared as a short independent paper, to correct some misapprehensions of Mr. Manning as to the cost of water-power. Not having seen Mr. Main's paper, I can only refer to a previous one published by him for the Mass. Inst. of Technology in 1886, and say, that as far as my experience goes, I can agree with him very fully in regard to the cost of steam-power, taking his case No. 2 as an example, but not in regard to the cost of water, in which he assumes the Essex Co. charge for extra water as a basis. If such charges are taken as a basis for the cost of water-power, they should be compared with the charges made for steam-power by lessors in Boston or Worcester, which range all the way from $50 to $100 per H. P.

I have given in these notes my views as to the cost of water-power, quoting Mr. Nathan Appleton for the original rates fixed at Lowell, which were closely followed by all the other large water-power companies in New England, but I omitted one very important statement made by Mr. Appleton before he mentions these rates, viz., that the first expenditure at Lowell for canals, etc., was $120,000, which was estimated to produce fifty mill-powers, of sixty net horse-power each.

This would be a cost of $2,000 per mill-power, so that the rental fixed on this, of $300 per year per mill-power, would be 12½ per cent. on the cost, which shows that this was the total charge for the water, and that the payment of the land, as I say hereafter, should not be included. With the old breast wheels giving about 70 per cent. this was called 60 horse-power, and would be $5.00 per one horse-power. With the modern turbine giving 80 per cent. it would yield 68 horse-power at $4.40 per horse-power, which I assume as the total charge for water.

Mr. Denton asked, in the discussion on Mr. Manning's paper, if any allowance was made for repair of dams, and I can say that the dams at Lowell and Manchester have been rebuilt by the Water Power Co., in dressed stone and cement, like the one at Lawrence, and are likely to last for centuries.

Also that the Holyoke Water Power Co. made no reduction in charges for water due to any change in ownership. The original Lowell basis has always been the standard for all, until the overuse of water necessitated the penal charges spoken of.

The paper on General Solutions of the Transmission of Force in a Steam Engine by D. S. Jacobus, was well received. Prof. Thurston expressed regrets that only the final formulas were given, and asked that the complete mathematical work be added before the paper is printed in society's reports, as the paper is a very valuable one.

Professor J. E. Denton in reading his paper on Cards from the Pawtucket Pumping Engine, with and without jacket, claimed that only three per cent. of saving was effected with the use of the jacket. In the discussion Mr. Charles Emery said that the paper is misleading, as it seems to convey the impression that only a saving of three per cent. is effected in all cases, whereas he has known cases in which the use of jacket gave a saving of 12½ per cent. Prof. Thurston said that undoubtedly the experiments were correctly made, yet the data given in the paper were incomplete, and that before the paper is printed in the society's reports the manner of conducting the experiments, and the mode of arriving at final results, should be furnished.

The last paper presented related to the Performance of the Double-Screw Ferryboat Bergen. The introduction was read by E. A. Stevens. Prof. Denton gave in detail the results of the experiments to determine the performance of the boat. We shall abstract from this paper in a later issue.

President Towne, in his concluding remarks, again referred to the short time left for the building of the world's fair, and said that, since attention should be given to sentimental ideas, he would suggest that the unveiling of a monument of Columbus, or the opening of one of the permanent buildings of the world's fair, be made the occasion for a celebration on the date of the four-hundredth anniversary of the discovery of America, and open the world's fair in 1893.

He also proposed that a committee be appointed to convey these expressions to Mayor Grant. A member proposed that, since there were a number of Western members present, a committee should also be appointed to convey the same expressions to the Mayor of Chicago. It was finally decided to notify the mayors of all large cities to that effect.

On Friday, the members, accompanied by the ladies, made an excursion, by steamer, on the North River and the Bay, to Elizabethport, N. J., and visited the works of the Singer Manufacturing Co. Luncheon was served on the boat by the courtesy of President Henry Morton, of the Stevens Institute, who made the society his guests.

On Saturday morning a party visited the steamship City of Paris.

## Despise not Trifles.

We have become so much accustomed to seeing machinery invade and conquer new fields nowadays, that comparatively little thought is bestowed upon each new invasion as it takes place, except by those directly interested in the conquest. It is but a short time since type-written letters, legal and other documents first began to be seen, yet now they are almost the universal rule. Scarcely any one took the type-writing machine seriously at first. It was regarded as more in the nature of a toy—a plaything—than as something which was to become literally mightier than the pen, and work a complete revolution in business correspondence. The first machines and the matter written on them were regarded as curiosities simply by almost every one, and scarcely any one imagined that within a few years the vast majority of business letters would be written by the rapid play of fingers over rows of keys, printing words at a rate of speed unapproached by the pen, and with a vast improvement in appearance and legibility. Most machinists even, we fancy, were rather inclined to despise the type-writer in its younger days, and were somewhat disposed to pity the men who could find nothing better to do than to tinker with such stuff. But the victory of the machine has been complete, and the business of making them has grown to be an important one, to the machinist no less than to others. Vast numbers of them are now made and sold, and the number is on the increase, it being now seen to be not at all improbable that, before many years, they will be as common even in households as they are now in business offices. The surprising development of the business may well teach machinists that there is scarcely any limit to the possibilities locked up in their business, and that any attempt to do a thing by machinery, which has heretofore been done by hand, is not to be despised, no matter how unpromising or trifling it appear to be.

What bids fair to prove a similar case is the automatic coin-operated machine; or "slot machines," as they are usually called. They have from the first been the butt of ridicule by the papers, and by nearly every one. Few grown people were seen patronizing them, except in a spirit of fun, or without first casting a glance about them, to see that no one was looking. But, nevertheless, they are growing in favor, and in all places where crowds of people are to be found, a great variety of things are to be had simply by "putting a nickel in the slot."

One of the latest varieties of the machine, is one which stands on the table of the writing rooms of hotels, and for a nickel delivers two postage stamps, which are clean and not stuck irretrievably together, as they usually are, when the traveler undertakes to carry them about with him. The machine thus makes an honest penny for its owner, and at the same time affords a real convenience to the traveler.

By this perhaps more than by any other use which has so far been made of the principle in this country, it is seen that the machine has passed the ridiculous stage, and must be considered as something which is to bear a part in the serious affairs of life. There is no telling how many salesmen have been displaced by the machine, but it is easy to see that it is destined to occupy a place in the work of distribution, which will be by no means despisable. One writer connected with a country paper, after a visit to New York, where he was confronted at every turn by a new variety of slot machine, gave the rein to his imagination, and predicted a time when the only people in the city who would have any work to do would be those who should go around and collect the money from the machines. That ought to be a fine condition of affairs for the machinist, only the question arises, where the money which was put into them would come from? But in the meantime, before that question becomes a serious one, it seems probable that the machinist will reap no inconsiderable harvest from the construction of them, and of the tools and machinery for making them. And when the money thus made jingles in his pocket, let him reflect and learn not to despise the small things nor the man, who proposes to accomplish what seem like small things by machinery.

A little incident is related of an engineer from "out west," who attended the recent meeting of mechanical engineers at New York. Conceiving that his boots would look better for being blackened, he summoned one of the youthful members of the fraternity who attend to that important branch of industry. The boy not only blackened his boots in a way to suit him, but he cleaned the mud stains from his clothes, and, literally quoting, "picked the hayseed from the back of my coat." The hayseed part of the matter is in the nature of an exaggeration, but it expresses the opinion that the job was well done, and the boy not only got complimented for his work, but he got fifty cents for what he had done. That engineer insists that the boy will yet be President of the United States. This is not much of a story, but the moral of it is bigger than a barn door.

We have received a prospectus of the Newark (N. J.) evening technical school. The school is free to young men, but as the examinations for entrance are held in June and September, we presume it is too late for the winter course. We have no doubt that the secretary, William N. Barringer, can give information on this point.

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## An Educational Crusade.

Any one who gives the subject attention, cannot fail to notice the fact that mechanics and engineers have entered upon what might be termed an educational crusade. In all parts of the country night schools are in operation, where, at a small cost, those who work days can put in evenings to advantage in studying mechanics and engineering, and at a very small cost in money. It is one of the hopeful signs of the times that these schools are being so well patronized, and yet there are a good many mechanics and engineers who could avail themselves of their privileges, but do not. The very fact, however, that so many are attending such schools, will force others to some such course, for there is always a premium on knowledge, and it will be found that those who are best equipped with it will be the ones who will rise the fastest, and who will command the best pay.

In many places where there are no night schools of this kind, one could easily be started, if mechanics would move in the matter. When men are determined to learn they can always find help in doing so.

In small villages, such a school need not be an elaborate affair. A room to meet in, and some one to direct the efforts of the students, is all that is required at the most, and these can be obtained anywhere. Many a young man now attending one of these night schools will become eminent, and he will owe it to having used his evenings to good advantage.

## Some Recommendations.

The New York State Railroad Commission has investigated the collision which took place on the New York Central road, Sept. 27, and recommends, among other things, that the road take into consideration the question of equipping the entire line with block signals, and particularly that portion between Spuyten Duyvil and Croton. Also that the road submit to the Board of Railroad Commissioners an estimate of the cost of the block signal equipment, "and of the practicability of the same so as not to interfere with the punctuality of the service, particularly of local trains." We do not know just what force the "recommendations" of the State Railroad Commission may have, but it will be noticed, perhaps, that there are some rather peculiar things about this recommendation when you come to look into it a little. For instance, it seems rather strange that such a road should be "recommended" to consider the matter of equipping with block signals. Does any one doubt for a moment that this question has been considered already on that road, and for some specific reason given up? To suppose that the management have postponed the consideration of such a question until recommended to consider it by a State board, is to suppose that the road is managed by persons who are lacking in intelligence, which, of course, would be an erroneous supposition. In all probability the question has been thoroughly looked into, and the objections to the adoption of the system will hardly be removed by simple recommendations. Then, too, it seems rather strange that the road should be asked to furnish estimates of the cost of the equipment, and an opinion as to its practicability.

If the Commission really wanted to know about these things, would it not have been more natural to go for information to roads on which the system is in use, and to the makers of the equipment? It is pretty certain that the management of the New York Central road knows pretty much all it needs to know on these points, and more than it is likely to tell the commissioners. And it has probably been concluded that it is better business for the road to do without the block signals, and run the risk of collisions, with their attendant troubles and expense. If this is the case then it is not probable that anything less than a very strong public opinion (strong enough to unfavorably affect the business of the road) or an exercise of positive authority, will produce any effect whatever.

## Information about the "Baltimore."

Another official trial of the Baltimore has taken place, and, at this writing, we begin to read dispatches from Washington, based on what is called "the preliminary official report." This report, we are informed, says nothing about horse-power, but the speed of the vessel is now declared to be 20.1 knots an hour, which is considerably faster than was developed by the last preceding trial. One dispatch states that "Calculations based on the record of 19.06 knots and 8,878 horse-power, made on the former trial, show that, to make 20.1 knots, she would have to develop about 10,500 horse-power." This may be true enough if the calculations are to be made in the ordinary way, but, in view of the fact that the calculations made on the former trial showed that an increase of speed was accompanied by a decrease of power, we should say that the present speed might indicate that the horse-power would fall quite low, say in the neighborhood of 8,000. Of course we cannot be exact, because the data upon which to base calculations on the falling off of power accompanying increase of speeds, are as yet, of course, very meager. The only thing we feel quite sure of is that we know no more about the Baltimore now than before, and that the more trials, and the more dispatches sent out from Washington regarding the trials, the less we shall know.

The State of Missouri passed an anti-trust law, which recently went into effect. By the provisions of this law, the charters of all companies that persist in remaining in a trust are revoked. A reasonable time was given the members of trusts to withdraw, and there has been a good deal of healthy action in this direction. The astonishing thing about the matter is the enormous number of trusts in the State. Of course attempts will be made to evade the law. If these attempts are not successful—if it is found that the law is effective—the example of Missouri is likely to be followed in other States.

According to all accounts, at this writing, the revolution in Brazil, by which the last monarchial government on this continent has gone out of existence, was accomplished in a peaceable manner. Dom Pedro, the emperor, appears to have taken the matter very sensibly indeed, and the people have conducted themselves with equal good sense. This augurs well for the new republic, which will doubtless become an important factor in commercial matters.

Recently one of the New York daily papers made merry over the fact that ex-Mayor Hewitt was obliged to wait his turn for an audience with the collector of customs at New York, because he was not recognized by the doorkeeper. The question naturally suggests itself, is not ex-Mayor Hewitt just as much entitled to wait as any other citizen? He ought to be proud of the honor of doing so.

## Literary Notes.

Robert Barclay, A. M., M. D., of St. Louis, Mo., sends us a pamphlet containing a reprint of a paper read by him before the National Association of Railway Surgeons convened at St. Louis. Dr. Barclay is "Consulting Aural Surgeon" to the hospital department of the Missouri Pacific and other railway lines, and he thinks that deafness of employes has a good deal to do with railway accidents, although seldom reported. A good many employes, he thinks, do not hear the warning sounds of the whistle, and says: "The lives of faithful employes, of passengers and freight entrusted to them, may be said to often hang upon the vibration of an otolith or auditory hair." The conclusion reached is that the services of the "Aural Surgeon" shall be called into use, and that he shall certify as to the qualifications of an aspirant before he can hope to secure a situation, and that the surgeon's care shall be over him in the interests of the company in case he stumbles against the hope of promotion.

The Doctor has undoubtedly given the subject due attention, and certainly if a man cannot hear the average American locomotive whistle he ought to be willing to give up work.

It may be, however, that when the aspirant for railway service, in addition to sorting and classifying rainbows, has to have the "vibration of an otolith" inquired into, he will get discouraged.

We have received from H. A. Curtin, the publisher, 65 Duane street, New York, a copy of the latest edition of the United States Directory. This directory contains classified lists of the trades and industries in the United States, also lists of importers, manufacturers, bankers, etc., in the principal cities of South America, Australia, New Zealand, Great Britain, and other countries. It is a book of more than 1,900 pages, and sells for $10.00.

## QUESTIONS AND ANSWERS.

*Under this head we propose to answer questions sent us, pertaining to our specialty, correctly and according to common-sense methods.*

*Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.*

(436) F. T. Lapeer, Mich., asks What is the proper size of a crank-pin for 2"x2" cylinder? *A.* The size of a crank-pin for an engine as small as here given depends more upon taste and good judgment than upon computation. We should make it about 3/8 of an inch diameter, and 1 1/4 of an inch long.

(437) H. W. S., Sacramento, Cal., asks: Where can I get the drawings of all the different parts of a locomotive? *A.*—We give nearly all of them in the articles on Modern Locomotive Construction, now running in the AMERICAN MACHINIST. We do not know of any book in which they are published.

(438) A. P. F., Augusta, Me., writes: Please give a description of a toy electric motor, one that can be made cheap and easy. *A.*—The best way for you to pursue will be to examine the toy electric motors in places where they are sold, and then make such improvements, if possible, as will enable you to make them cheaper and easier.

(439) H. F., Toronto, Canada, asks: What power will a compound marine engine of the following dimensions develop? Boiler pressure, 130 pounds; high-pressure cylinder, 4x7 inches; low-pressure cylinder, 7x7 inches; steam cut off in the high-pressure cylinder at 4 3/4 inches; keel condenser with pumps; 350 revolutions. *A.*—About 30 indicated horse-power. 2. Will such an engine drive a boat 35x7 feet? Lines are good; draught forward, 1 foot 10 inches; aft, 2 feet 10 inches; 4-bladed propeller, 30 inches diameter, 45 inches pitch. *A.*—Yes. In our opinion the engines are too large for the boat. 3. What percentage of slip will occur? *A.*—About 25 per cent. 4. Would a 34-inch two-bladed propeller, 51-inch pitch, give better results in such a boat? We may say it is a pleasure boat, and not required for any other purpose. Parties desire the highest speed. *A.*—We believe the diameter of this propeller will be too large for the draught of water, as a portion of the propeller will be out of the water, or too near the surface. A propeller 30 inches diameter and 51-inch pitch will give better results.

(440) O. B., New York, writes: Heretofore we have rented the steam power, but now we will have to furnish it ourselves. We would like to know what size of boiler in horse-power will be adequate for our work. We have to supply steam to a 10 horse power hoisting engine, one Worthington duplex pump, 6"x4"x6", and another of the same make, 4"x2"x4". We also want to heat, every three hours, 750 gallons in an open tank, to as high a temperature as possible. *A.*—The data you have given is very unsatisfactory; for instance, you do not state the temperature of the water which is to be heated, nor the precise temperature after the water has been heated. We shall assume that the temperature of the water before it is heated is 50° F., and after heating it will be 212°. For driving the hoisting engine and pumps, also for heating the water, you will need a boiler with 400 square feet of heating surface, and about 16 square feet of grate surface. In commercial transactions it is customary to allow only 10 square feet of heating surface per horse-power; at that rate you will need a 40 horse-power boiler. If 15 square feet of heat-

ing surface are allowed per horse-power, you will need about a 26 horse-power boiler. 2. How many cubic feet will 1,500 gallons contain? *A.*—200.52 + cubic feet. 3. What must be the size of tank and thickness of iron to hold 1,500 gallons? The tank is not to have any braces. *A.*—You do not state whether the available space for the tank will limit the diameter or height of the tank. You will evidently need a cylindrical tank. If it can be made 6 feet in diameter it will have to be 7 feet 2 inches high. For the bottom of the tank we should use iron one-quarter of an inch thick, and for the shell about No. 10 (American gauge) galvanized iron. Our advice to you is to engage a good mechanical engineer, and let him select the boiler and make all necessary calculations, and arrange the boiler, tank, etc., to the best advantage. We believe you will save money by adopting this course.

(441) J. E. B., Philadelphia, Pa., writes: Please inform me how to calculate the pressure upon a 1⅜-inch bolt, six threads to the inch. The force exerted by a man is 130 pounds, at the end of a 48-inch wrench. *A.*—It is impossible to find by computation the exact pressure or tensile stress on the bolt, because friction will have to be allowed for, and this will depend upon quality and finish of the material, also on the conditions of surfaces in contact. The following method will probably give a close approximation of the pressure: Assuming the force to be applied at 48 inches from the center of the bolt, the force will travel through the circumference of a circle 96 inches diameter, or through a distance of 301.59 inches; and in the meantime the nut will travel in the direction of the axis of the bolt, through a distance equal to the pitch of the thread, or one-sixth of an inch. Leaving friction out of consideration, and, for the sake of illustration, assuming the nut to be working against a spring, we will, with a force of 130 pounds at the end of wrench, produce a pressure of

$$\frac{301.59 \times 130}{\frac{1}{6}} = 301.59 \times 130 \times 6 = 235{,}240.2 \text{ pounds.}$$

Now, assuming that seven-eighths of the applied force is required to overcome the friction in screwing the nut against solid metal, and the remaining eighth produces a pressure on the bolt, we have

$$\frac{235240.2}{8} = 29{,}405 \text{ pressure on the bolt, sufficient to}$$

injure it permanently.

(442) L. T., Montreal, Canada, writes: Will you kindly give us the breaking strength of I and channel iron beams. Makers' tables, as a rule, omit the safe loads to be carried by channel iron, and for either section where safe loads are given, fail to say what the factor of safety is. *A.*—Makers of this class of iron beams generally allow a load on these beams which will bring a maximum strain of 12,000 pounds per square inch, and, in the book published by the New Jersey Steel and Iron Co., is said to be about one-quarter the breaking strain of wrought-iron. Loads which give a maximum strain of 12,000 pounds are those which can be carried with safety in addition to the weight of the beam itself, when the beams are supported at both ends, and the load uniformly distributed over the length of the beams, which are secured against deflection sideways by filling in between them with brick arches, or in any other suitable manner. Beams unsupported sideways, of any considerable length, are liable to fail under a much lighter load by yielding laterally. The maximum fiber strain of 12,000 pounds is sufficient for all building purposes. Where beams have to carry moving loads, as in bridges, etc., this maximum fiber strain should be reduced, but for entirely permanent and dead loads it may be increased with safety up to 16,000 pounds per square inch. The safe uniformly distributed load, including the weight of the beams which I or channel iron bars will support, can be found by the following formula, the web of either bar being placed vertically:

$$\text{Safe load distributed} = 8\,\frac{S\,I}{l\,e},$$

where $S$ is the maximum fiber strain, in this case, 12,000 pounds; $I$ is the moment of inertia, $l$, the length of beam in inches, and $e$ the distance of the most extreme fiber from the neutral axis; for beams of symmetrical cross-section $e = \frac{1}{2}$ the depth of the beams. Example.—It is required to find the uniform distributed load which a wrought I beam can support safely. The depth of the beam is 10½ inches, the distance between the supports is 13 feet; the weight of beam is 105 pounds per yard. In the book published by the New Jersey Steel and Iron Co., this beam is called a light beam, and its moment of inertia is 185.6, as given in the same book. Now substituting the values for the symbols in the formula, we have

$$8\,\frac{12{,}000 \times 185.6}{13 \times 12 \times 5.25} = 21{,}735 \text{ pounds.}$$

But this includes the weight of the beam, which must be deducted. The weight of the beam is

$$13 \times \frac{105}{3} = 455 \text{ pounds,}$$

and 21,755 — 455 = 21,300 pounds, or 10.65 tons at 2,000 pounds per ton The book referred to gives 10.77 tons as the safe load. The same formula is used for finding the safe uniformly distributed load which channel iron bar supported at both ends can carry. Of course care must be taken to pick out the correct moment of inertia. Here it may be asked: What is meant by the moment of inertia? It is the sum of the products obtained by multiplying small areas of the cross-section, into which it may be divided, by the square of their distances from a line drawn through the center of gravity of the cross-section, this line being perpendicular to the web Of course this definition of the moment of inertia is only applicable to the cases here considered.

## BUSINESS SPECIALS

*Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Thursday for the ensuing week's issue.*


Gear wheels and g-cutting. Grant, see adv., p. 16.

Link-Belting and Sprocket Wheels.

Send for Catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Engineering Co., Philadelphia and N. Y.

Shafting Straighteners. J. H. Wells, Tampa, Fla.

Steel Name Stamps, etc., J. B. Roney, Lynn, Mass.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

The Improved Justice Hammer. Williams, White & Co., Moline, Ill., manufacturers.

R. Dudgeon, 24 Columbia st., New York, Improved Hydraulic Jacks and Roller Tube Expanders.

Pattern and Brand Letters. Vanderburgh, Wells, & Co., cor. Fulton and Dutch sts., New York.

Davis Key-Seating Machines kept in stock by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

The best Upright Hammers run by belt are made by Jenkins & Lingle, Bellefonte, Pa.

Ice and Refrigerating Machines, 140 sold, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

"How to Keep Boilers Clean." A 96-page book mailed free by Jas. E. Hotchkiss, 120 Liberty st., N.Y.

Selden Packing for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Prestoline & Prestoline Paste, for cleaning & polishing metals. S. A. Smith, 23 S. Canal st., Chicago.

Iron Planers from 16″ to 36″ wide by any length. H. C. Pease & Co., Worcester, Mass.

R. G. Du Bois, 715 11th St., Washington, D. C. Procures first class patents on inventions. Write.

Locomotive Driving-Box Planer Tool. Pedrick & Ayer, Philadelphia, Pa.

Special Tools for Railway Repair Shops. Pedrick & Ayer, Philadelphia, Pa.

For the latest Improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Send $1 for Catalogue D, Fine Tools and Supplies. Over 550 pages. Fully illust'd. Free when $10 worth goods are ordered. Frasse & Co., 92 Park Row, N. Y.

Curtis Pressure Regulators. Curtis Return Trap. Curtis Damper Regulator. See Nov. 14, p. 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa.

For Portable Key-seating Machines and Stub Ends for small connections, address T. C. Dill Machine Co., 726 Girard ave., Philadelphia, Pa.

Screw Plates with Round Adjustable and Split Dies; also, Tap Wrenches. A full line by S. W. Card & Co., Mansfield, Mass.

25″ 28″ 32″ 36″ Upright Drills a specialty. Finely made, great capacity, quickly operated, prices low. Send for list of firms using our Drills. J. E. Snyder, Worcester, Mass.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet illustrating pumping machinery and reports of duty trials.

25″ 32″ 37″ 42″ "Only Drill Press built on 'Ko-rekt' principles, even if they come from Jersey." Gould & Eberhardt, New Ark, N. J.

Steam Boilers: Their management and working on land and sea. By Jas. Peattie. Practical facts from 30 years' experience. 230 pages. Illustrated, 12mo., cloth, $2. Circulars and Catalogue of Books for engineers free. E. & F. N. Spon, 12 Cortlandt st., N.Y.

De Lamater Screw Propeller Wheel made only by The Samuel L. Moore & Sons Co., Elizabethport, N. J., who have purchased from C. H. De Lamater & Co., New York, all their patterns, books of record, gauges, etc. Location and equipment well adapted for Heavy Steamship Repairs.

H. B. Roelker, 22 Cortlandt st., New York, late Sup't De Lamater Iron Works, will hereafter manufacture the De Lamater Screw Propeller. Propellers of same pattern and workmanship as formerly made by the De Lamater Iron Works. Each designed for its special work at lowest prices. Consulting Expert and Constructing Engineer. Estimates made on machinery and on damages.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

"Practical Drawing." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October 23, 1886 issue, and up to and including October 10, 1889 issue, 87 articles have been so far published. Copies containing these articles sent by mail to any part of this country or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

"Modern Locomotive Construction." By J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world Commencing with the June 27, 1885 issue, 101 articles have thus far appeared up to and including the October 3, 1889 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton st., New York.

C. H. De Lamater & Co. have closed their extensive manufactory at the foot of West 13th street, New York, and have sold the Hot Air Pumping Engine and Steam Pump business to the De Lamater Iron Works (incorporated in 1889), and the Propeller Wheel business to the Samuel L. Moore & Sons Co., of Elizabethport, New Jersey.

In order to close out the remainder of the stock, offer for sale a very desirable lot of machinery, such as lathes from 15″ to 88″ swing, planing machines 48″x45″x10′, 53″x50″x12′, 17″x14″x24′, 72″x69″x24′, and various other sizes; drilling machines, slotting machines, shaping machines, boring machines, bolt-cutting machines, cutting-off machines, nut tappers, milling machines, gear cutters, emery tool grinders, portable drills, screw-cutting machines, vises, lathe and planer tools, and a variety of small tools; also traveling and jib cranes.

Punching and shearing machines for boiler makers, with a general outfit of small tools. Blacksmiths' tools, such as anvils, sledges, tongs, etc. Pattern lathes, benches, saws, screws, nails, and a general supply of small tools. Foundry cranes, cupolas and small tools. Blocks, ropes, bolts, nuts, washers, packings, pipe and fittings, iron and brass valves. Boiler iron, steel plate and boiler rivets. Bar iron and steel, also steam hammers and two 8″x16″ and one 10″x20″ Rider cut-off engines.


## MANUFACTURES

Large steel works will be built at Greensburg, Pa.

Hicks & Holmes will build a machine shop at Cordele, Ga.

Gwyn & Chatham, Elkin, N. C., will put new machinery in their woolen mill.

The Whitney Gun Company, Northampton, Mass., propose an increase of plant.

Ferguson & Robinson will build a machine shop and foundry at Loudon, Tenn.

The Hatcher Iron Wagon Manufacturing Co. are erecting works at Columbus, Ga.

The Rogers Furnace Co., of Detroit, Mich., has been incorporated, with a capital of $100,000.

The National Capital Street Car Motive Co. is building a machine shop at Washington, D. C.

The L. C. Bass Manufacturing Company has been organized, to manufacture woodenware, at Guilford, Maine.

The Birmingham, Bessemer & Powderly Dummy Line Co. are building a machine shop, 70x90 feet, at Trevellick, Ala.

Notices have been posted at all the furnaces in the Mahoning Valley, Ohio, granting an increase in wages of 10 per cent.

The Grand Rapids (Mich.) Mattress Factory was recently seriously injured by fire. It will be put in running condition without delay.

The Standard Foundry Co., St. Louis, Mo., have put in an electric light plant to facilitate the night work which they are obliged to do.

The Fall River Mill Supply Co. has been organized at Fall River, Mass., for manufacturing and selling mill supplies and machinery.

The Orange Knitting Company has started business at Orange, Mass. They expect to largely increase their machinery in the near future.

The Briarfield Coal and Iron Company, Briarfield, Ala., has been reorganized, not only to put the old mills in operation, but to build new mills.

A disastrous fire occurred recently at the works of the Columbus (Ohio) Steel Range Co. The company expect to be in condition to fill all orders by Dec. 1.

The New Cumberland (W. Va.) Light, Heat and Power Company has been formed by A. Haigh, R. E. Lindsay, H. McMahon and others, with a capital stock of $50,000.

The Taylor Wire Nail Company, Pittsburgh, Pa., will move their works to Elkton, Md., if a free site is donated and $20,000 to $40,000 in stock is subscribed by Elkton parties.

The Citizens' Gaslight Company, of Bloomington, Ill., has decided to add electricity to its plant, and will spend $50,000 in establishing an electric system, which will be the third in operation in that city.

The Long & Allstatter Company, Hamilton, O., are adding a story to their main building. The building is 60x200, and the improvement will make it four stories high, adding about 15 per cent. to their capacity.

The Eagle Iron Works, St. Louis, Mo., have purchased a large adjoining building, and will cut the walls out so as to connect this building with the one at present occupied. Electric lights will be put in all the buildings.

Valk & Murdoch, operating a foundry and machine shop at Charleston, S. C., have incorporated as the Valk & Murdoch Iron Works, with a capital stock of $100,000. They are enlarging their works, doubling capacity of iron foundry and boiler shop.

W. P. Harvey has signed a contract to transfer his knit goods plant, now located at Valatia, N. Y., to Tallapoosa, Ga. His capital is $100,000, and he employs 100 hands. Tallapoosa gives him a site, $7,500 in cash, and fifty lots that are to be sold by him for $200 each.

The National Smelting and Refining Company, Kansas City, Mo., are erecting new works on the Santa Fe Railroad, at Turner's Station, seven miles west of the city. The company has secured 150 acres of land there, and will erect large refining works at that place.

The Homestead (Pa.) Mills of Carnegie, Phipps & Co., are to be enlarged at an early date, by the addition of eight open-hearth steel furnaces. The work of pulling down a number of old buildings, to make room for the new plant, is going on at present, and the plans for the improvements are about prepared.

George B. Grant has divided his works, having one shop at Boston and another at Lexington, Mass. The Boston jobbing and all the light gear work is done at the Boston Gear Works, 137 High street, while the Lexington works have been fitted with more special reference to heavy work.

The stockholders in the new Steiner & Moore Whip Company, of Westfield, Mass., have organized with L. W. Steiner for president, George T. Moore, vice-president, and E. A. Kenyon, secretary and treasurer. The capital stock is $25,000. Manufacturing will be vigorously pushed as soon as the machinery is all up.

The Ohio Falls Car Company has recently closed a contract with the Central of Georgia for 1,200 freight cars, and 22 coach, baggage, mail and express cars. This is one of the largest contracts ever secured by the company, and, with the other contracts already on hand, will keep the works running until next summer.

The stockholders of the United Electric Lighting Company, Springfield, Mass., voted this week to increase the stock from $150,000 to $300,000, to meet the expenses incurred in enlarging the plant and carrying out the contract with the city. About 1,200 of the 1,500 shares were subscribed for on the spot, and the directors are authorized to sell all that is not taken by December 15.

The Case Manufacturing Co., Columbus, Ohio, are now occupying their new shops. Both the wood shop and the machine shop are 60x200 feet, and the paint shop and room for heavy wood-working is 60x150 feet. Besides these there are other buildings. The company purpose building a new foundry and warehouse, and believe that, when completed, they will have the largest establishment in the country.

The Morse Elevator Works, fronting on three streets, at Frankford ave., Wildey and Shackamaxon streets, Philadelphia, turn out an average of three elevators daily, mostly for freight purposes. No one looking through their factory can help seeing that good work is done there, all drums being turned and grooved out of the solid metal, etc. Worm gears, an improved safety device, self-closing doors, and other features, are specially noticeable. The works employ 118 men.

There is water-works agitation at Miamisburg, Ohio; Flagler, Iowa; Oxford, Ga.; Iron Mountain, Mich.; Gaysport, Pa.; Lagrange, Texas; Crystal Springs, Miss.; Palmyra, N. Y.; San Bernardino, Cal.; Vandalia, Ill.; Bear Gulch, Cal.; Eaton Rapids, Mich.; New Hampton, Ia.; Edwardville, Ill.; Ukrah, Cal.; Needham, Mass.; Seattle, Wash.; Springer, N. M.; Graysport, Pa.; Wichita Falls, Tex.; Brodhead, Wis.; Eagle River, Wis.; Siloam Springs, Cal.; Moscow, Idaho; Pittsford, Vt.; Oxford, Ala.

The New Process Rawhide Company, Syracuse, N. Y., issue a two-leaf circular, in which are set forth some of the superior qualities of their product. Amongst other things, the company makes blanks for rawhide gears, and these gears are coming into quite general use for a variety of purposes, especially where the absence of noise is particularly desirable. The quality of this rawhide is such that it can be cemented together, no pins or collars being required. This rawhide is also used for chisel handles, mallets, and for a variety of purposes.

The Williams Engine Works, Beloit, Wis., have just begun work in their new shops, and are already crowded with orders. A line of triple cylinder high-speed engines, ranging from 100 horse-power up, is being added to their regular list of compounds. The demand is principally for electric light and power service. The main shop is 88x145, provision being made for extension in length. A 15-ton Shaw electric crane covers a width of 40 feet through the middle, and the selection of tools and general arrangement of the plant is in accordance with the best modern practice.

The great Bear River canal in Utah, for the construction of which $2,000,000 has been provided, is expected to be one of the most extensive irrigation works in America. To get the river along the side hill along the Bear River canon and out on to the plain near Plymouth will necessitate moving 220,000 cubic yards of solid rock, 19,000 cubic yards of loose rock, 1,528,000 cubic yards of earth, and digging 1,200 feet of tunnel. This canal will irrigate 200,000 acres in Salt Lake valley, and 6,000,000 on Bear river, increasing the value of the land to $50 per acre, while fencing, building and tillage are expected to double this valuation in a few years. Bear Lake is in southeastern Idaho. The reservoir for this canal covers 150 square miles, and the canal will secure the irrigation of a territory extending to Ogden.—*Merchants' and Manufacturers' Journal.*

A manufacturing town is being rapidly built up at Sparrows Point, Md. In addition to the present large blast furnace and other plant in active operation, there are a number of buildings either being constructed or finished for manufacturing purposes. A pattern shop, having a width of 64 feet 8 inches, and a length of 94 feet, has just been partly completed. The iron foundry is near by the pattern shop. This building is 140 feet wide, and has been finished to 150 feet long. Close to those works there is being erected a pump house. Furnaces are also under construction, which will supply steam to work the machinery of these new works. It is hoped to have in active operation by the new year the second blast furnace, which is known as furnace B. About 100 new cottages are nearly completed. Last month the company had on its pay rolls 750 men, of whom 300 are residents at the Point.

## Machinists' Supplies and Iron.

NEW YORK, Nov. 23, 1889.

Iron—American Pig.—There is practically no change in prices, but consumers are keeping close up to production, and prices are kept firm. We quote No. 1 X Foundry, $18.50; No. 2, $17.50.

Scotch Pig.—There are but few transactions in Scotch brands. Quotations are: Coltness, $27.50; Summerlee, $27; Langloan, $26.50; Dalmellington, $24.

## WANTED

*"Situation and Help" Advertisements only inserted under this head. Rate 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.*

Competent agents wanted to represent a meritorious & paying steam specialty. Business, AM. MACH.

Wanted—Position as foreman of machine shop. Exp'd in gen'l work. Refs. Box 55, AM. MACH.

Exp'd draftsman and mach. desires engagement as draftsman or ass't sup't. D. 9, AM. MACHINIST.

Wanted—1st-class mechanical draftsman. State experience and salary. Balto. Sugar Refining Co., So. Baltimore, A. A. Co., Md.

Foreman and contractor wanted, who can handle men and do good work promptly. Address Steam Engine, care AMERICAN MACHINIST.

Wanted—Experienced and thoroughly competent foreman for pipe foundry starting in Canada. State terms. Address Foundry, AMERICAN MACHINIST.

Mech. draftsman with two years' practical exp. wants situation; graduate of a German tech. college. Salary moderate. Address Box 51, AM. MACHINIST.

Experienced mech. draftsman, age 25, with tech. education and shop exp., wishes permanent situation. East preferred. Refs. Box 53, AM. MACH.

Wanted—Position as engineer; have had charge of a steam plant for several years. Thoroughly competent. Best refs. Box 40, AMERICAN MACHINIST.

Wanted—Foreman boiler works who can manage about 25 men and get out good work at lowest cost. Address A. J. P., AMERICAN MACHINIST.

Correspondence desired with reliable concern in need of foreman for getting out automatic and stat'y engines in quantities. Ref. Box 54, AM. MACH.

Mech. engineer and draftsman wants situation. 2 years engineering college, 9 years' practical exp. in shop and drawing office. "Kings," AM. MACH.

Machinists Wanted—Vise hands accustomed to first-class work. Steady employm't and liberal wages guaranteed. Have largely increased our plant and need more men. Niles Tool Works, Hamilton, O.

Wanted—An exp'd traveling salesman, accustomed to handling specialties, and well known to the engine builders and trade throughout the country, is open for engagement Jan. 1st. Satisfactory refs. Address Box 52, care AMERICAN MACHINIST.

Wanted—A first-class foreman for small foundry. Must understand casting brass castings. Foundry in first-class shape; heated by steam. Address, with ref. and price per day (for the right man a permanent position can be obtained), E. K. Hayes, Galva, Ill.

Wanted—An exp'd foundry foreman for a general class of work. Also foreman of malleable iron dep't, or a person competent to take charge of both. Permanent employment at stated salary, or will furnish plant, materials, etc., and purchase the castings by the ton. Address "Manufacturer," AM. MACHINIST.

By a live man, agency for mfg. co. Commercial experience, familiar with accounts, correspondence, sale and purchase of machinery, and can take full charge of branch house. Understands mach'y and its details, worked as machinist and draftsman. Can earn $2,500 salary. Address Box 1987, Boston P. O.

Wanted—A competent foreman for mach. works; must be skilled in general designing, construction and iron work, and thoroughly accustomed to the handling of men, together with executive ability. The best refs. given and expected. State wages wanted, and address Foreman, AMERICAN MACHINIST.

## MISCELLANEOUS WANTS

*Advertisements will be inserted under this head at 35 cents per line, each insertion.*

20" Lever Drill Presses, $65. S. M. York, Cleve'd, O.

Koopman's Scales for quick measurements.

Glass Triangles. F. E. Harthan, Worcester, Mass.

Just out; aluminum-steel hack-saws, hard but not brittle. Crescent Mfg. Co., Cleveland, Ohio.

New catalogue of engineers' specialties free. Crescent Mfg. Co., Cleveland, O.

Light and fine machinery to order; Foot Lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

August C. Christensen, 24 State st., N. Y., Consulting Engineer. Designs of all kinds of Machinery.

Turned and Highly Polished Iron and Steel Shafting a specialty. Merwin McKaig, Cumberland, Md.

Complete list of our Scales and other new tools for 2c. stamp. A. T. Koopman, Chicago.

D. J. Kelsey, M. E., Designer of Automatic Machinery, 31 Insurance Building, New Haven, Conn.

Wanted—Patents of merit to manufacture and introduce. Box 46, AMERICAN MACHINIST.

Wanted—Light mach. work and spec. to manufac., on contract. Electric Mfg. Co., Greenbush, N. Y.

Small foundry and machine shop for sale. A good thing cheap. Address L. W. Shafer, York, Pa.

Engineers wanted to send their addresses and receive free a 25 cent book, "Hints and Suggestions for Steam Users." Lord & Co., P. O. Box 1262, Phila., Pa.

Boiler maker with tools and capital would like to hear of a location for boiler shop. Address C. G., AMERICAN MACHINIST.

Hawkins' Gear Calculator instantly finds gears (simple and compound) for screw cutting. Price 50c. G. S. Hawkins, 35 Vanderbilt st., Brooklyn, N. Y.

For Sale—An established mach. business, protected by valuable patents. Can be much enlarged by judicious management. C. M. W., AM. MACHINIST.

Wanted—To buy second-hand lathes, planers and shapers of all sizes; must be cheap and in good order. Fosdick & Plucker, 6th and Culvert Streets, Cincinnati, O.

How to remove and prevent scale in steam boilers at a cost of ten cents a week. Send postal for circular to Pittsburgh Boiler Scale Resolvent Co., Pittsburgh, Pa.

Wanted—Live business man to buy interest in machine business mfg. specialties now being sold throughout U. S. Good business opportunity for right man. Address Central, care AM. MACHINIST.


Established 1832. BRADLEY'S POWER HAMMERS
The BEST in the WORLD
RUN BY BELT.
Over 1500 in USE
BRADLEY'S HEATING FORGES
Indispensable in all shops to keep BRADLEY'S CUSHIONED HAMMERS and men fully employed and reduce the cost of production.
BRADLEY & CO. SYRACUSE, N. Y.
63 Murray st. NEW YORK: 98 Sudbury st. BOSTON, MASS

JOHN WILEY & SONS, NEW YORK, PUBLISH
WILSON'S STEAM BOILERS, 12mo, cloth, 2.50
THURSTON'S MANUAL OF STEAM BOILERS, 8vo, cloth, 6.00
FORD'S BOILER MAKING, 18mo, cloth, 1.00
THURSTON'S STEAM BOILER EXPLOSIONS, 12mo, cloth, 1.50
GRIMSHAW STEAM ENGINE CATECHISM, 18mo, cloth, 1.00
DITTO DITTO VOL. II. 18mo, cloth, 1.00
WHITHAM STEAM ENGINE DESIGN, 8vo, cloth, 6.00
HEMENWAY'S INDICATOR PRACTICE, 12mo, cloth, 2.00
PRAY'S TWENTY YEARS WITH INDICATOR, 8vo, cloth, $2.50
DESCRIPTIVE CATALOGUE GRATIS.

OUR NEW CATALOGUE OF TOOLS
And Supplies sent free to any address on receipt of Ten Cents in Stamps (for postage).
Chas. A. Strelinger & Co., WOOD AVE. Detroit, Mich.

$75 "Star" Foot Lathe Swings 9x25 in. LATHE Screw Cutting Automatic Cross Feed, etc.
Scroll Saws, Circular Saws, Lathes Mortisers. LATHE Catalogue Free of all our Machinery.
Seneca Falls Mfg. Co., 687 Water St., Seneca Falls, N. Y.

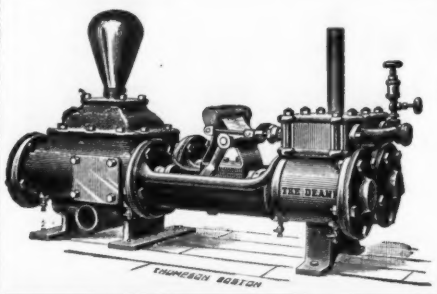
CHARLES MURRAY
ENGRAVER ON WOOD
58 ANN ST. NEW YORK.

WILLIAM JESSOP & SONS, L'D.
MANUFACTORY, SHEFFIELD, ENGLAND. Chief American Office, 91 JOHN ST., NEW YORK.
JESSOP'S BEST TOOL STEEL
Gold Medal, Paris, 1889.
Importation Orders Promptly filled. ALL KINDS OF Steel in Stock.

PATENT UNIVERSAL SCREW-CUTTING CENTER DEPTH ANGLE AND
J. WYKE & CO., TWIST DRILL GAUGE.
Fine Machinists' Tools.—E. Boston, Mass.—Send for Circular

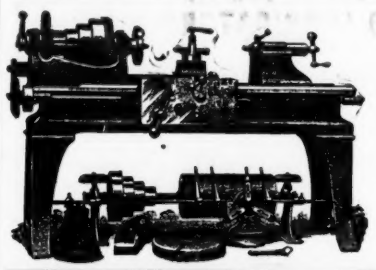
PATTERNS called for and CASTINGS delivered anywhere in N. Y. City.

Iron Foundry of T. Shriver & Co.,
333 E. 56th St., N. Y. City.
CASTINGS IN QUANTITY AT FAVORABLE PRICES.



THE DEANE STEAM PUMP CO.,
HOLYOKE, MASS.,
New York, Boston, Chicago, Philadelphia, St. Louis,
Manufacturers of
STEAM and POWER
PUMPS
FOR ALL PURPOSES.
SEND FOR CATALOGUE.

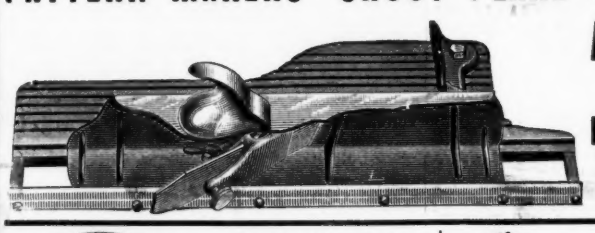
"CRESCENT EXTRA"
Is now used by many of the largest and most carefully managed shops for all Lathe and Planer Tools, Punches, Dies, Taps, Reamers, &c.
This steel is famous for its uniformity and great endurance, and should be specified by Machinists and Tool-makers who want the best stock for their tools.
CRESCENT STEEL WORKS,
CHICAGO, ILLS. PITTSBURGH, PA. NEW YORK, N. Y.



SEBASTIAN, MAY & CO.'S
—NEW—
18-in. Engine Lathe.
Just introduced. New design. All the latest improvements. Write for cuts and prices. Complete catalogue of foot and power lathes and tools mailed on application.
167 W. 2nd Street, Cincinnati, Ohio.

TOBIN BRONZE
Tensile Strength upwards of 79,000 lbs. per sq. in.
Torsional Strength equal to the best Machinery Steel.
Anti-Frictional and Non-Corrosive.
CAN BE FORGED HOT.
Rods for pumps and bolts. Yacht shafting. Rolled sheets and plates for pump linings and condenser tube sheets, &c. Ingot metal for car and engine bearings. Spring wire.
ANSONIA BRASS & COPPER CO., Sole Manufacturers.
Send for Circular. CHICAGO. NEW YORK.

PATTERN MAKERS' SHOOT PLANE & JACK BOARD.



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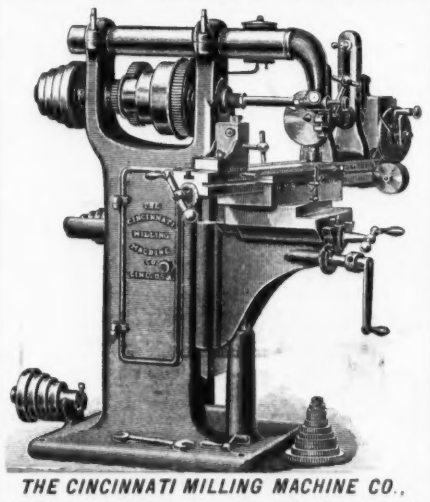

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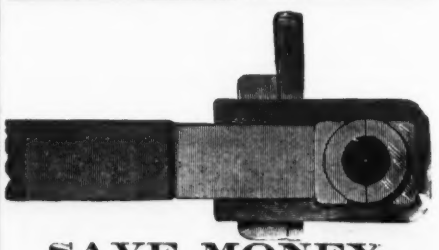

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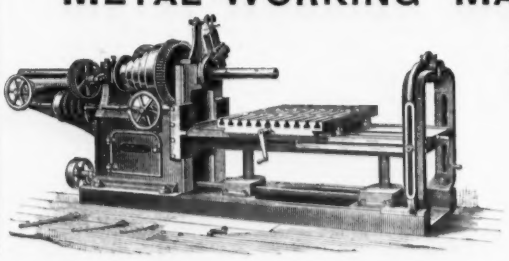

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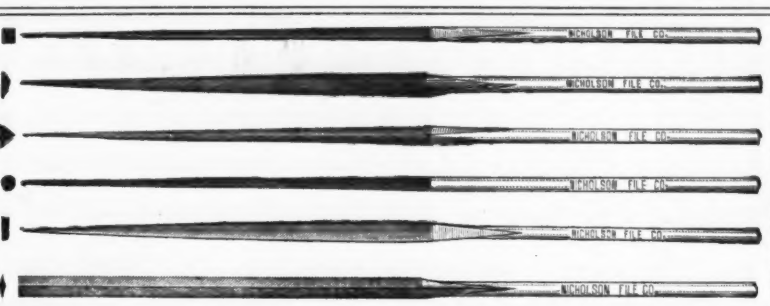


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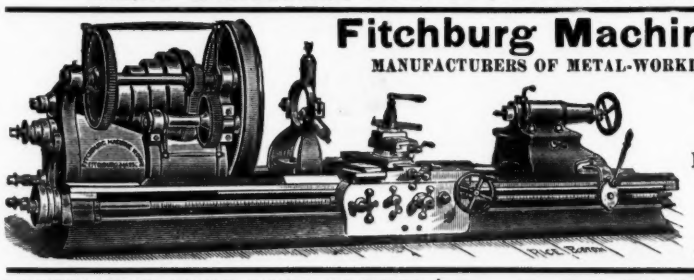

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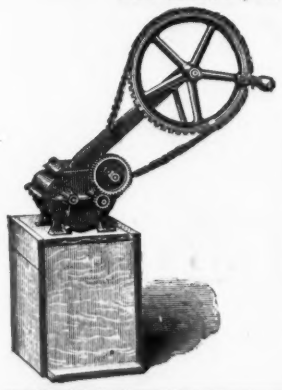

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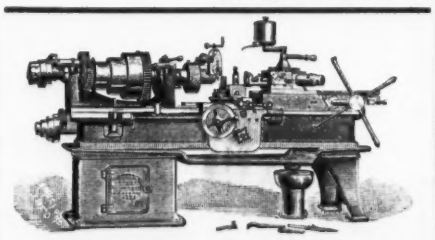

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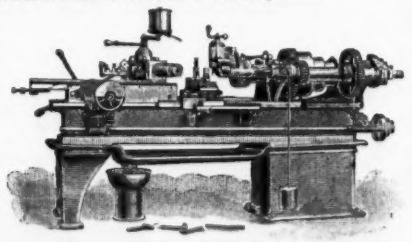

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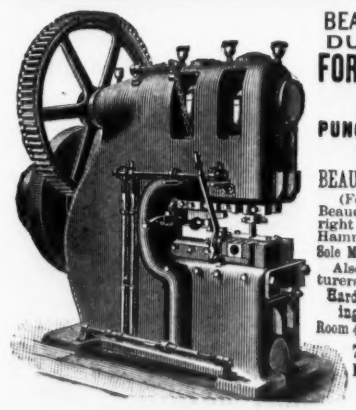

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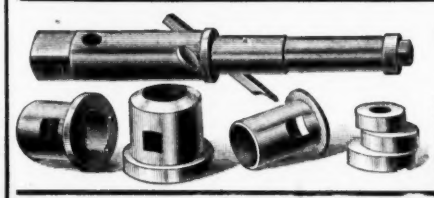

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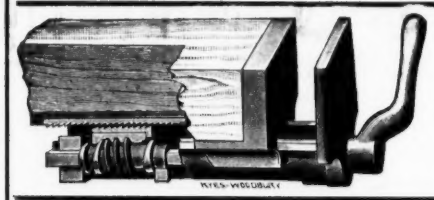

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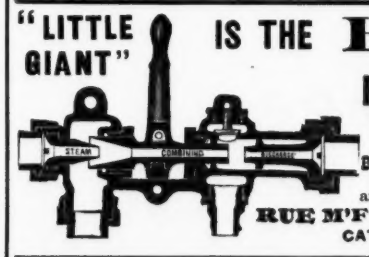


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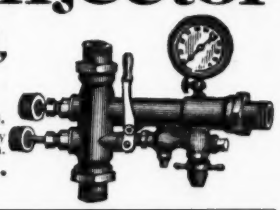

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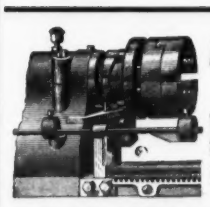

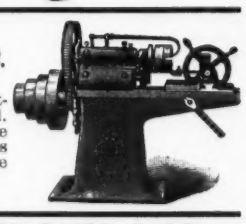

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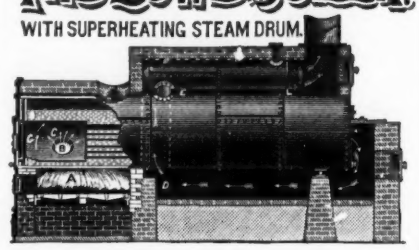

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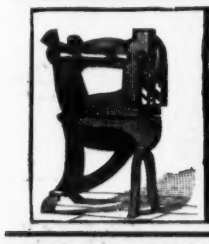

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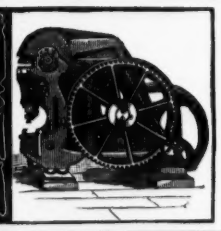

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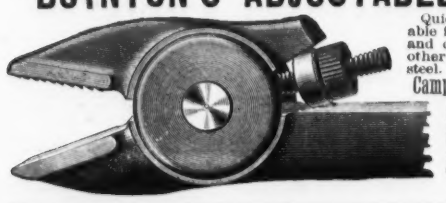

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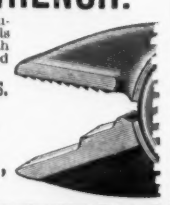

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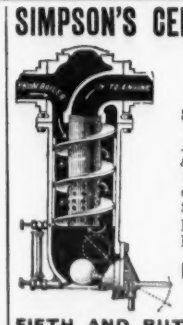

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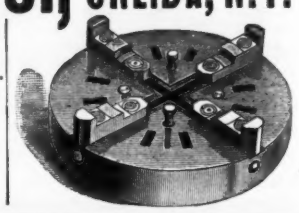
| 15¼ " | 17 " |
| 18 " | 19¾ " |
| 21 " | 25½ " |
| 24 " | 28 " |



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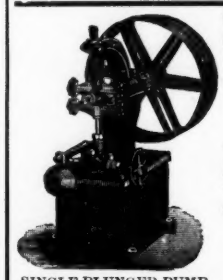

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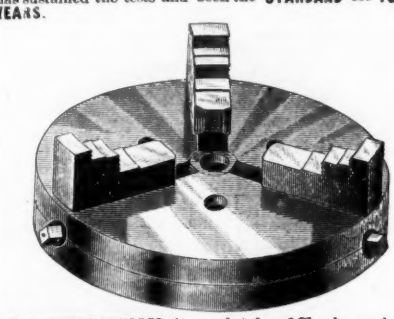

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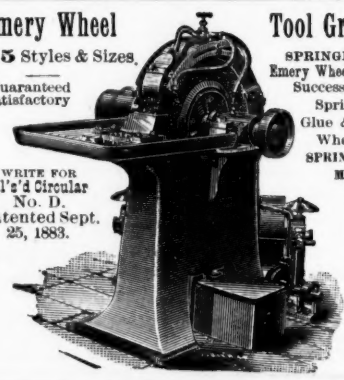

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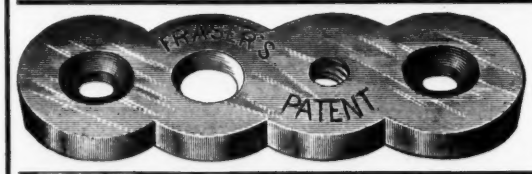


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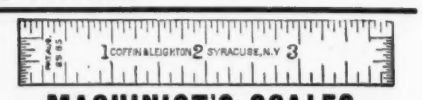


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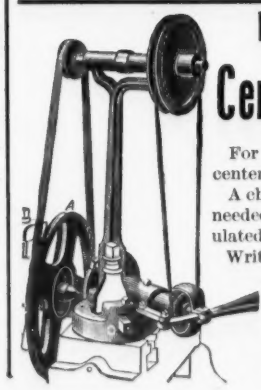

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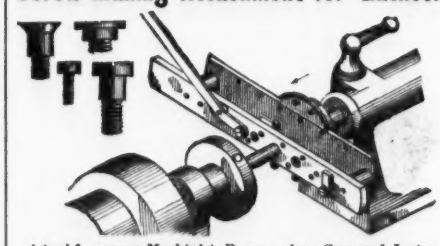

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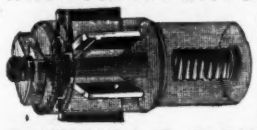

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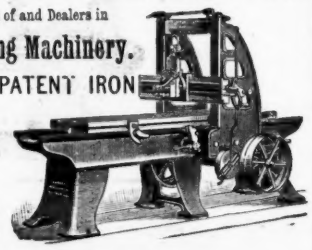

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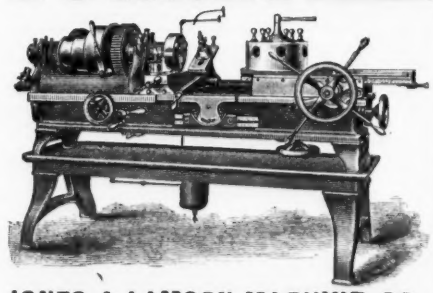

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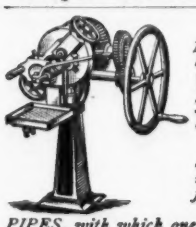

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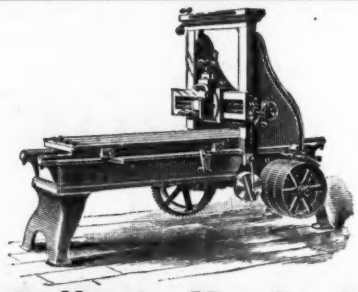

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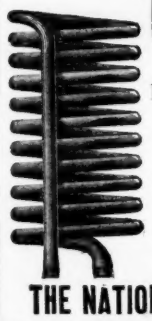

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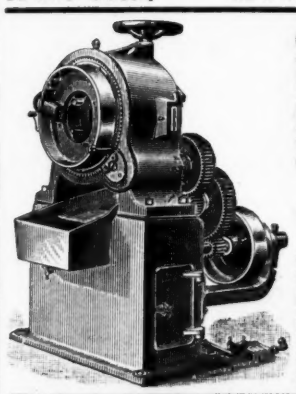

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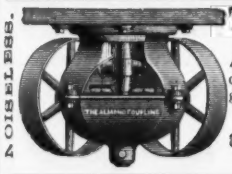

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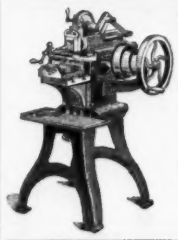

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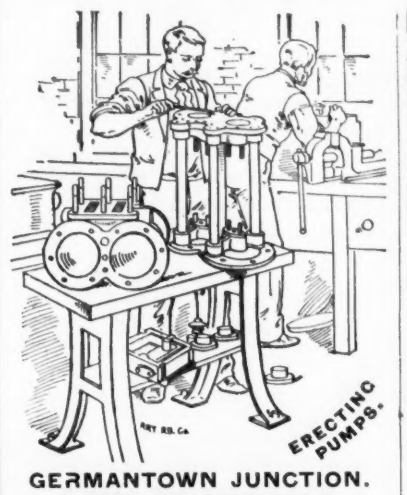


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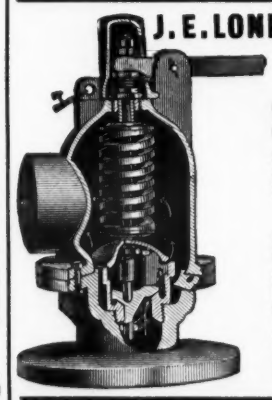

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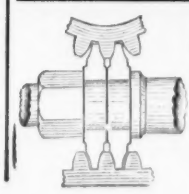

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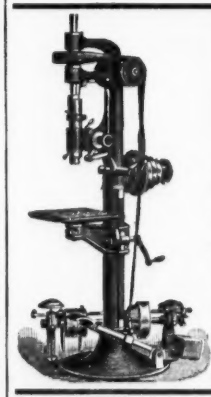

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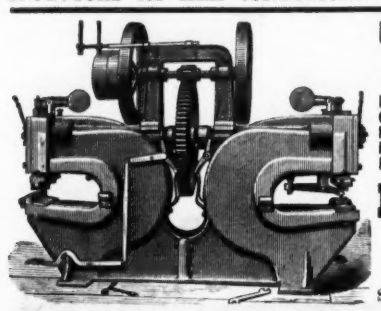

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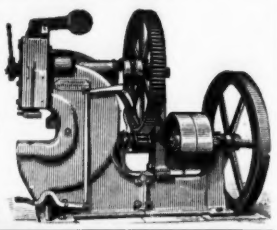

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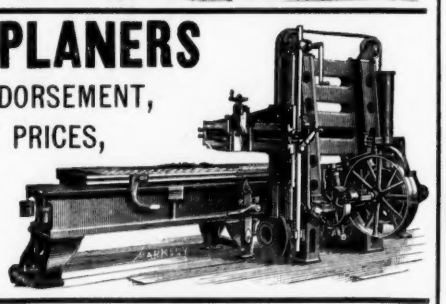

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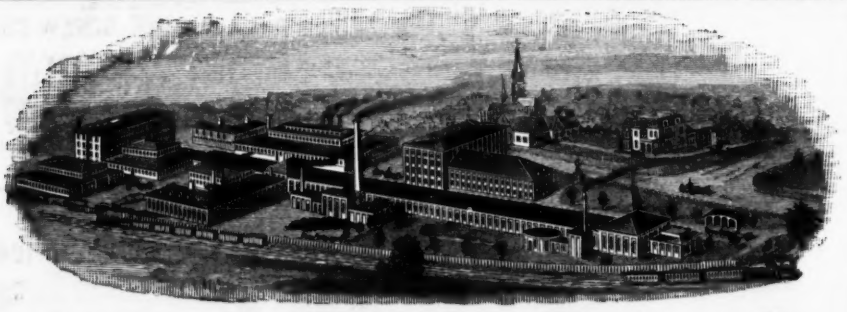

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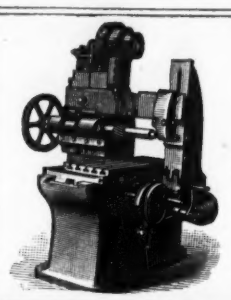

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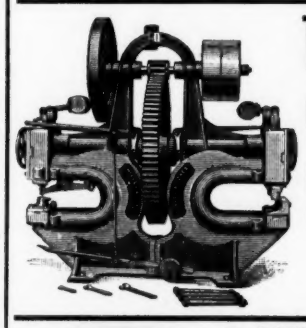

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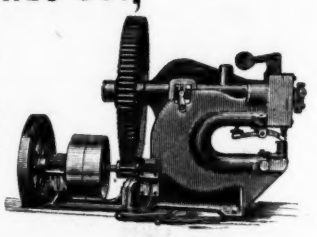

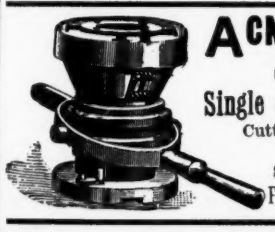

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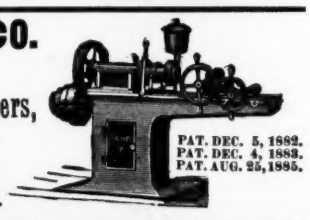


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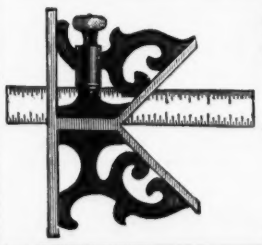

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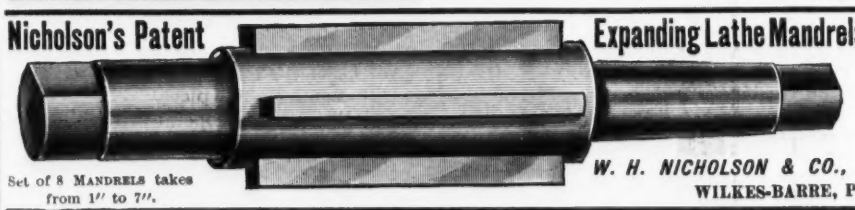

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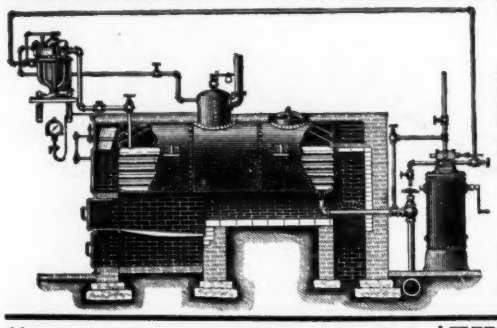

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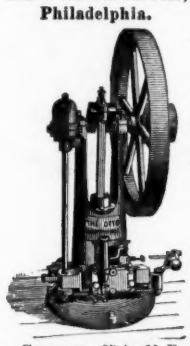

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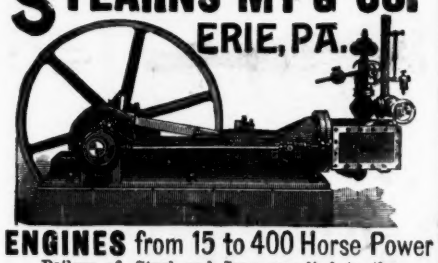

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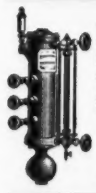

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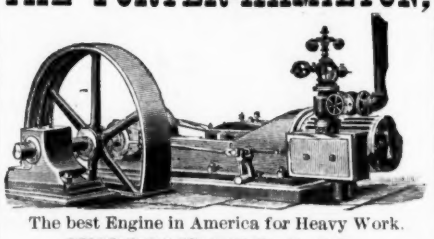

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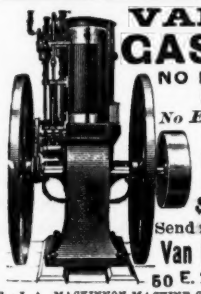

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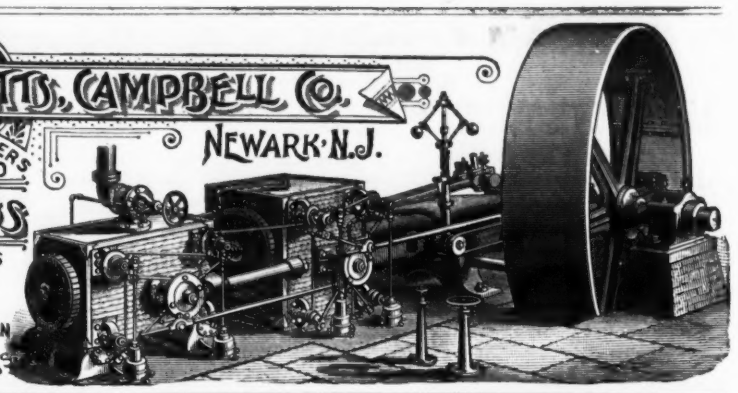

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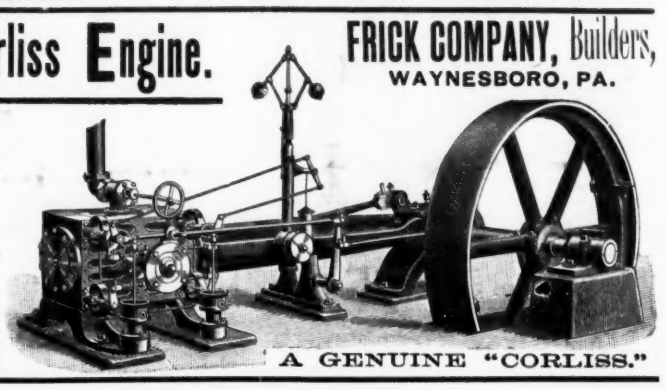

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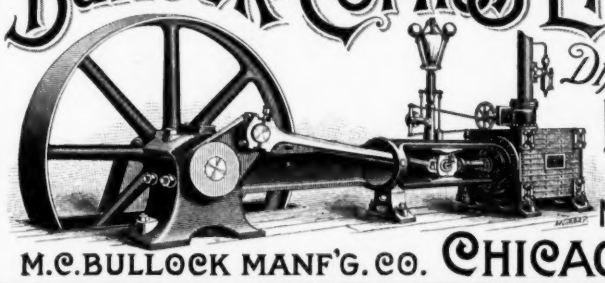

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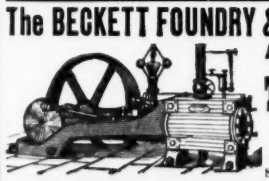

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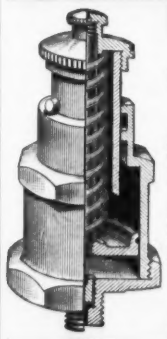

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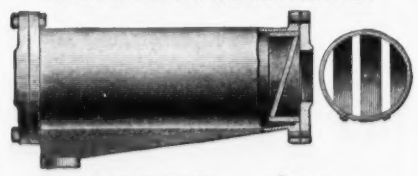

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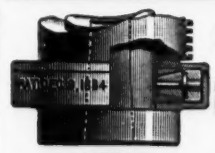

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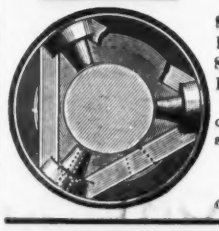

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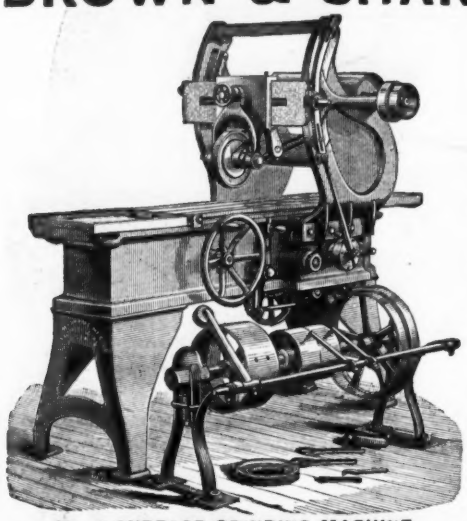

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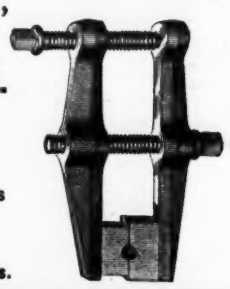

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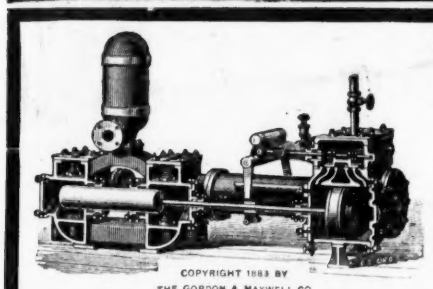

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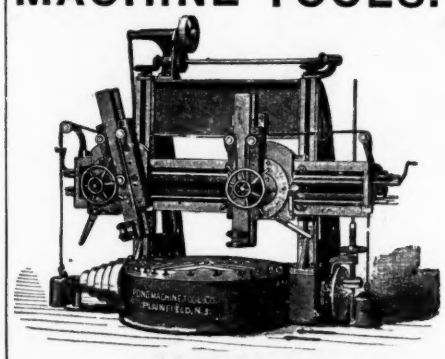

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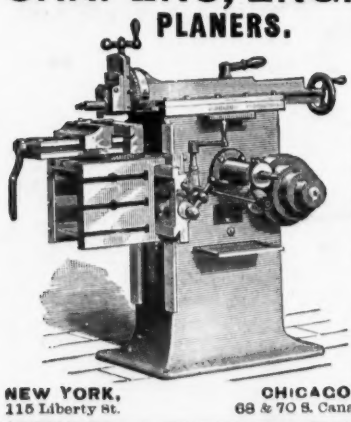

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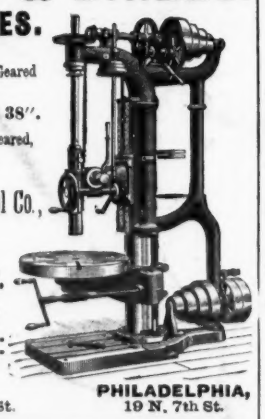

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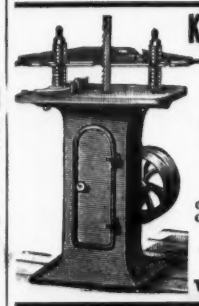

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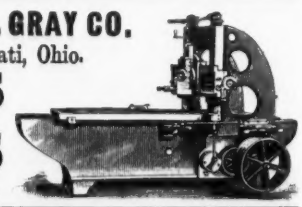

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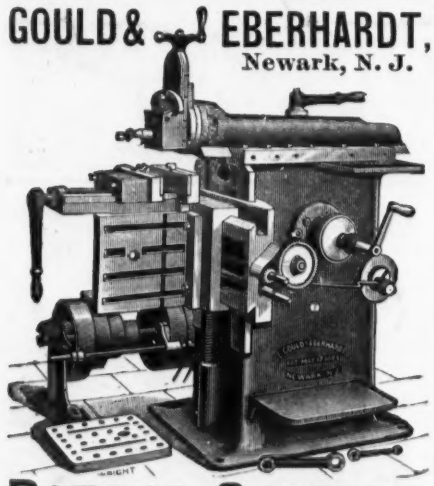

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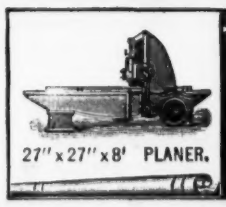

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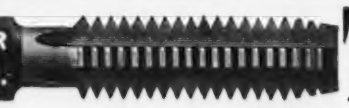

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